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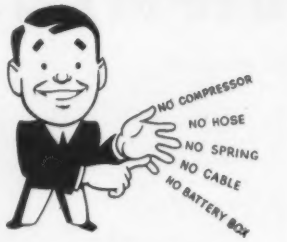

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Founded in 1896

Devoted to the interests of the engineers and technical officials of cities, counties and states

Vol. 78, No. 2

W. A. HARDENBERGH and A. PRESCOTT FOLWELL
Editors

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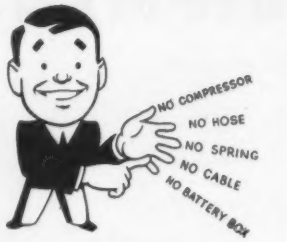

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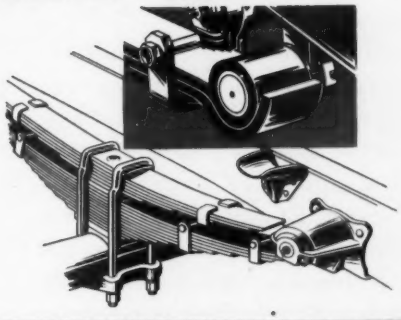

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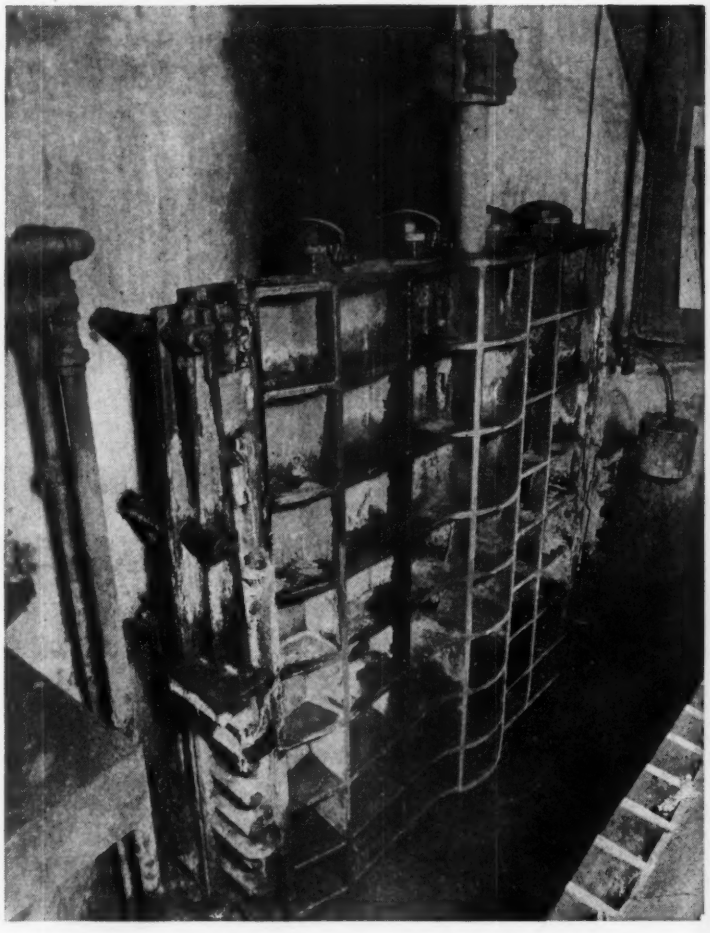
Time-tested *Everdur* Gets the call at New Jamaica Sewage Plant



THIS 8-ft. x 8-ft. main influent control and stop gate at the Jamaica Sewage Treatment Plant of the City of New York, with an unseating load of 50 tons, is restrained by 1" diameter Everdur* bolts imbedded in the concrete. The 4 ¼" diameter operating stem and all other bolts and mounting parts are also made of The American Brass Company's group of Copper-Silicon Alloys.

This equipment was designed and furnished by Krajewski-Pesant Mfg. Corporation, complete with the 32" diameter oil-pneumatic cylinder operating mechanism.

For the past 19 years, Everdur has demonstrated its ability to provide the exceptional corrosion resistance required to give long life under the severe conditions of sewage service. As a result, Everdur is frequently specified at those points where the most destructive conditions are encountered. For detailed information on Everdur Copper-Silicon Alloys in sewage and water works service, write for Publications E-11 and E-5. 49217

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Where Everdur Serves in New Jamaica Plant...

In four grit ejectors: Everdur for gate slides and cylinders piston rods, valve stems, bolts and nuts.

In two inclined 20-foot diameter revolving disc screens: Slotted Everdur plates for cone and disc.

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When you need special information—consult the classified READERS' SERVICE DEPT., *pages 69-73*

The Editor's Page

The Problems of Our City Streets

It is pretty apparent to all familiar with the problem that the street systems of most cities are vitally in need of sound engineering attention. These streets represent a very large investment on the part of the communities, often more than $200 per capita of the population; and they are essential to the welfare and existence of the community. Some solution must be found to the problem of repairing them; of modernizing them; and of making them contribute more effectively to the prosperity of the people they should serve. This must be done within the financial abilities of the community.

The first step should be to make a physical inventory of what now exists in each community and what is needed to meet present and probable future needs. A few years ago, one of our midwest cities made such a physical inventory and on the basis of it, the city engineer prepared a long-range program of improvement. On this program were indicated those things needed immediately, those things that should be done in the near future; and those things that were desirable, but might be deferred. The next step was the working out of a budgetary plan for street improvements which are within the ability of the city to meet.

If every city had such an inventory and such a plan, there would be a basis for a planned program that would meet the needs of service to the community and would conserve the tremendous investment that cities have in their street systems.

How Long Will Our Cities Last?

Compared to most of our industrial corporations, the span of life of our political entities—our cities, counties and states—is vastly greater. There have been few casualties among cities; none among counties or states; but the death rate of our corporations is relatively high. Few of us expect that our home town will not be there, bigger and better than it is now, in 50 or 75 years.

Curiously, however, industry does not hesitate to buy the best and longest lasting equipment, while our water, sewerage, street and highway departments too often tend toward the use of cheaper and shorter-lived equipment. Do our municipal and county engineers and officials lack faith in the future, or have they overlooked the obvious?

To us it seems mere common sense that when we put materials underground in a city water system, or a city sewer system, or when we build a road or a bridge, we ought to put into them the best planning and the best material that money can buy. It will never cost less to install than it does in the original construction, and whatever extra cost it may involve initially amounts to very little annually and will be saved many times over by freedom from need for early replacement and by lower maintenance.

Some may say that laws make it impossible for the public engineer to buy other than the cheapest material. That pretty much is mouse talk and not man talk, except in rare and unusual cases; and we personally never saw any law that required an engineer to use poor material. The community hires him to do a good job; it expects him to use good material and good equipment; and there is no need or excuse for doing anything else.

Safeguarding Ship and Railroad Water Supplies

The problem of safeguarding ship water supplies was one of the most difficult water supply problems of the war. The necessity for using every ship, and of crowding them with personnel far beyond their peacetime capacity accentuated the problem. Water purification on board ships still remains as a peacetime problem to be solved. Proper control of chlorine dosage, for instance, is difficult because a ship is not always a stable platform. For that reason super and dechlorination, with a residual persisting to the moment of use, has many advantages in assuring a safe water.

Railroad water supplies are somewhat in the same category because there are too many opportunities for pollution of passenger car water even if it has been taken from presumably safe water mains. The present car watering devices are highly fallible, to put it politely. Here again, as in the case of ships, an adequate and assured persisting chlorine residual seems to be more than desirable.

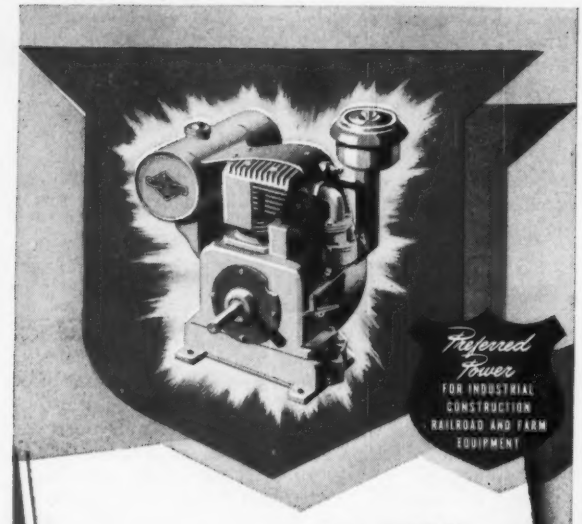
The development of satisfactory methods for ship and railroad water treatment is one of our important immediate problems. We have been playing with these problems for more than 20 years and even though much may have been accomplished, there is still a great deal more to be done to reach a par with other sanitary engineering progress.

The Time to Plan for Personnel Selection and Training

Just now, when any kind of personnel is hard to get, and more especially technical personnel, is the time to plan for personnel selection and training. It is the time to study what kind of men you will want in the future, and to establish standards of training and experience for them. An analysis of the unsatisfactory personnel you are now getting may provide a basis for evaluating those essentials that you want in your future personnel; and the trouble that you may have with your untrained staff to-day may point the way to the training program that you should establish for the future. In selecting personnel, it may prove desirable to establish experience requirements, and to impose certain other selection tests.

Picking good men properly equipped for the work they will be called upon to do is the primary essential in building a good staff. Then, having these good men, it is important to give them a good start by a course of training covering the fundamentals of their jobs. Topsy just grew, but she wasn't much when she got grown.

Careful picking, a good start on the new job, and a continuation of training as is necessary to make the men capable and confident reduces the number of personnel failures and increases staff efficiency. It is no kindness to give a man a job he can't perform—no kindness to him nor to your organization.



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More than 2¾ million Briggs & Stratton engines built during the past 26 years furnish conclusive proof that "It's powered RIGHT when powered by Briggs & Stratton".

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For complete information as to the many ways Ferri-floc will help lower your operating costs in the treatment of water, industrial wastes, sewage, and sludge conditioning write the Tennessee Corporation, Grant Building, Atlanta 1, Georgia, TODAY.

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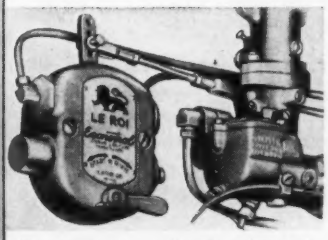
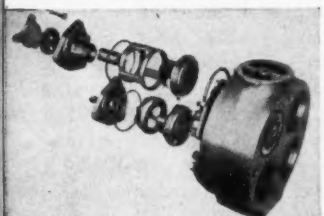
Portable Air Power AT ITS BEST

that's what users say about dependable, economical LE ROI AIRMASTER



Here it is in one handy unit — the Econotrol's simplicity makes it foolproof and trouble-free. There are no complicated adjustments to be made. Dependable regulation plus slower piston speeds provide unusual economy, as well as long and faithful performance.



A micron — one millionth of a meter — that's the kind of accuracy that goes into AIRMASTER valves. The direct, vertical, low-lift, cushioned action of these unique valves further assures long life.

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Sure, we've tested AIRMASTERS and tested them thoroughly. The results prove that they are unexcelled — that they produce air at low cost and with little trouble. But, despite our 30 years of compressor-engineering experience, we didn't stop there. We didn't want our own pride in doing a swell job of designing to influence our final decisions. That is why we shipped AIRMASTERS to all parts of the country.

Here's what happened — orders were received in greater quantities than ever before (except during the war years when we built over 6,500,000 cfm of portable air power for the armed forces). Dependability and economy were given as the basic reasons for buying AIRMASTERS. Here are just two of the many features that are partly responsible for the money-saving performance of these outstanding portable compressors:

The patented, fuel-saving Econotrol adjusts engine speed to the job-air requirements — acceleration and deceleration are gradual; fuel economy greater; engine and compressor life longer. Furthermore, the Econotrol maintains higher average working pressures so that air tools do more work.

Cushioned, Super-finished AIRMASTER Valves provide the most efficient, trouble-free means of *delivering* air. All the valves; i.e., intake, discharge, high and low pressure are 100% interchangeable. They are individually magnafluxed, and the accuracy of their seating surfaces is measured in microns. This accounts for their long life and high efficiency.

AIRMASTER sizes range from 60 to 500 cfm. All styles of mountings are available, and you can have your choice of gasoline or diesel-engine power. Get the most out of your equipment dollar — get portable air power at its best — get an AIRMASTER*. See your nearest Le Roi distributor or write for bulletins giving complete details.

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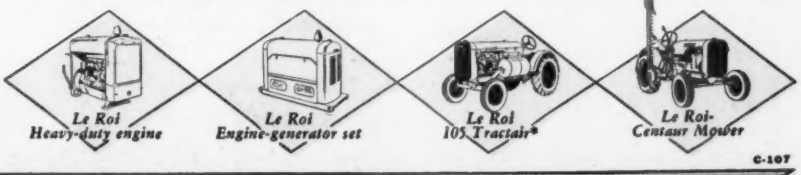


Le Roi Heavy-duty engine — *Le Roi Engine-generator set* — *Le Roi 105 Tractair** — *Le Roi-Centaur Mower*

C-107

Johns-Manville answers 13 QUESTIONS frequently asked about TRANSITE* PRESSURE PIPE

*Transite is a registered Johns-Manville trade mark

1. What is Transite Pipe's flow coefficient?

The conservative "C" value for Transite Pressure Pipe is 140, based on the Williams and Hazen formula.

2. Is Transite Pipe subject to tuberculation?

No! Transite's asbestos-cement composition is assurance that its original high carrying capacity cannot be reduced by tuberculation.

3. What economic advantages result from Transite's immunity to tuberculation?

Transite's complete freedom from tuberculation provides substantial savings in the initial cost of the system as well as in maintenance and operating costs.

It means, first, that you don't have to resort to larger-than-necessary pipe to offset the progressive reduction of carrying capacity caused by tuberculation. Without "over-designing," you can specify minimum size pipe to do the job intended—providing flow for present needs and those incident to increasing population and industrial growth.

It means also that the pipe you install *now* won't have to be cleaned, lined, reinforced with additional mains, or replaced altogether because tuberculation has clogged its interior and reduced its original carrying capacity.

4. How about pumping costs?

Here again, Transite's non-tuberculating asbestos-cement structure pays off. In a Transite line it is not necessary to increase pumping pressures to compensate for the effects of tuberculation. Thus, pumps can operate at higher efficiencies—an economy which is helping to keep down water rates for the taxpayer in many communities served by Transite water lines.

5. Does Transite withstand corrosive soils?

In just about every type of soil, Transite has demonstrated its superior resistance to soil corrosion. This statement has been substantiated by impartial comparative studies conducted both by government and private agencies.

For example, one series of studies revealed that the corrosive effect of many types of aggressive soils on Transite Pipe was practically negligible after exposure over an extended period. Other pipe materials subjected to the same tests were substantially affected by corrosion, but the strength of the Transite Pipe actually increased under identical test conditions.

Another indication of Transite's unusual corrosion resistance is its performance in coal mine service. Here, the conveying of acid mine drainage waters is a severe test of the corrosion resistance of any pipe—so severe that the life of a drainage line is sometimes measured in terms of months or only weeks. Yet under these conditions some of the earliest coal mine installations of Transite Pipe, laid more than 12 years ago, are still in use today. Several of them have

When you need special information—consult the classified READERS' SERVICE DEPT., *pages 69-73*

outlived the mines in which they were originally installed and are now serving in new operations.

6. What about electrolysis?

Electrolysis is no problem in a Transite water line, for Transite, being non-metallic, is immune to electrolytic action. You can lay this pipe alongside street car or power lines or in the proximity of power stations, with complete confidence that it cannot be harmed by stray ground currents.

7. How about strength?

Three factors contribute to the high uniform strength of Transite Pipe:

1. Its tough, strong asbestos-cement composition (asbestos fibers have a tensile strength as high as 400,000 lbs. per square inch).
2. The method used to form the pipe during manufacture—it is built up under tremendous pressure into a dense, homogeneous structure.
3. The special curing process which follows the forming operation and develops maximum strength in the finished product.

And, Transite's resistance to virtually all types of soil corrosion is assurance that the strength which is built into this pipe at the factory *is built in to stay!* Its record of successful performance under adverse conditions is proof that Transite *maintains* its strength.

8. Does Transite Pressure Pipe provide tight joints?

Yes. Due to the Simplex Coupling, joint troubles in Transite lines are few and far between.

The design of the Simplex Coupling is simplicity itself. Consisting only of a Transite sleeve and two rubber rings, it is, in effect, a factory-made joint which is merely *assembled* on the job. The operation requires only that the sleeve be pulled over the ends of the pipe, which rolls and compresses the rubber rings into place between sleeve and pipe. Thus rubber, which provides one of the most effective of seals, safeguards the tightness of the line. Furthermore, each joint is readily checked for proper assembly as the pipe is laid, providing advance assurance that the line will pass leakage tests.

And because it is a *flexible* joint, the Simplex Coupling offers an important additional advantage after the pipe is in service. Its flexibility helps compensate for soil movement and other stresses to which the pipe may be subjected, thereby helping protect against joint leakage. This also provides a safeguard against washing away of the supporting soil and possible pipe breakage.

9. How much deflection is possible at the joints?

A deflection of 5° or more at each joint is possible on most installations of Transite Pressure Pipe—an important advantage when laying pipe around curves and in hilly terrain.

10. What installation economies does Transite provide?

It is an exceptionally economical pipe to handle and install. The lightweight sections make the use of mechanical handling equipment unnecessary except for the largest sizes. The Simplex Coupling employed assures a fast assembly job in the trench. Under most conditions, the pipe can be laid as fast as the trenching machine can do its work. In fact, because of this feature, many installations have been made with the same foreman supervising both excavation and pipe laying. And because of its rapid assembly, pipe installation jobs are completed sooner, minimizing street tie-ups and traffic annoyances.

11. Are service connections easily made?

Yes. Transite Pipe can be drilled and tapped with standard tapping tools and methods. Connections are strong and watertight. Connections to valves and fittings, cut-ins for valve insertions and branch take-offs, etc., are made by conventional methods.

12. In what diameters is Transite Pressure Pipe made?

Designed for both supply and distribution lines, Transite is made in diameters ranging from 3" up to 36".

13. What working pressures will Transite handle?

Four classes are made—for working pressures of 50, 100, 150 and 200 pounds per square inch. To assure an ample factor of safety, each length of pipe and each coupling is factory tested before shipment at four times its specified working pressure.

Have you any further questions?

If you would like additional information about Transite Pressure Pipe, send for brochure TR-11A. Or if you prefer, ask to have a Johns-Manville representative call. Address Johns-Manville, Box 290, New York 16, N. Y.

JOHNS-MANVILLE JM PRODUCTS

Johns-Manville TRANSITE PRESSURE PIPE

An Asbestos Product

SIMPLEX PITOT EQUIPMENT

For *LOW COST, ACCURATE* WATER SURVEYS

Water Waste Surveys • Pump Discharge Checks • Plant Test Work

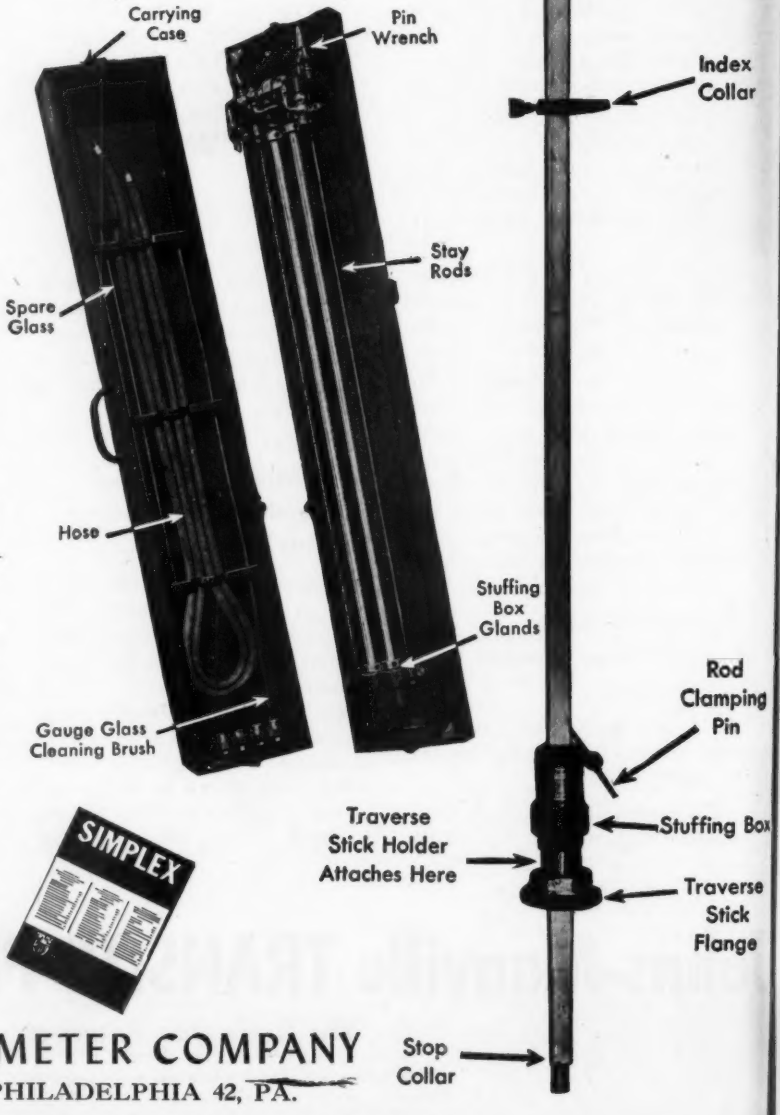
The Simplex Pitot Rod, Manometer and Pitot recorder are specifically designed for all tests or surveys where flow of water is concerned. These units are portable and yet ruggedly designed to withstand the continual movement from station to station.

The modern, streamlined, Type PF Pitot Rods are now available in standard lengths of 1′8″, 2′6″, 3′6″, 5′0″ and longer if required, to accommodate any diameter of pipe encountered in modern industrial plants.

Normally the Simplex Outfit #1, consisting of the Pitot Rod and Manometer, is all that is required for a comprehensive water waste survey. The portable Type MLC Recording Instrument is available for those who require a permanent record. 8″ diameter, evenly spaced, circular charts are employed with this recorder.

Simplex Valve and Meter Co. has had long experience in conducting water waste surveys and offers this modern line of survey equipment as the finest and most economical unit for this purpose.

We will be pleased to furnish additional information on the use of this equipment.



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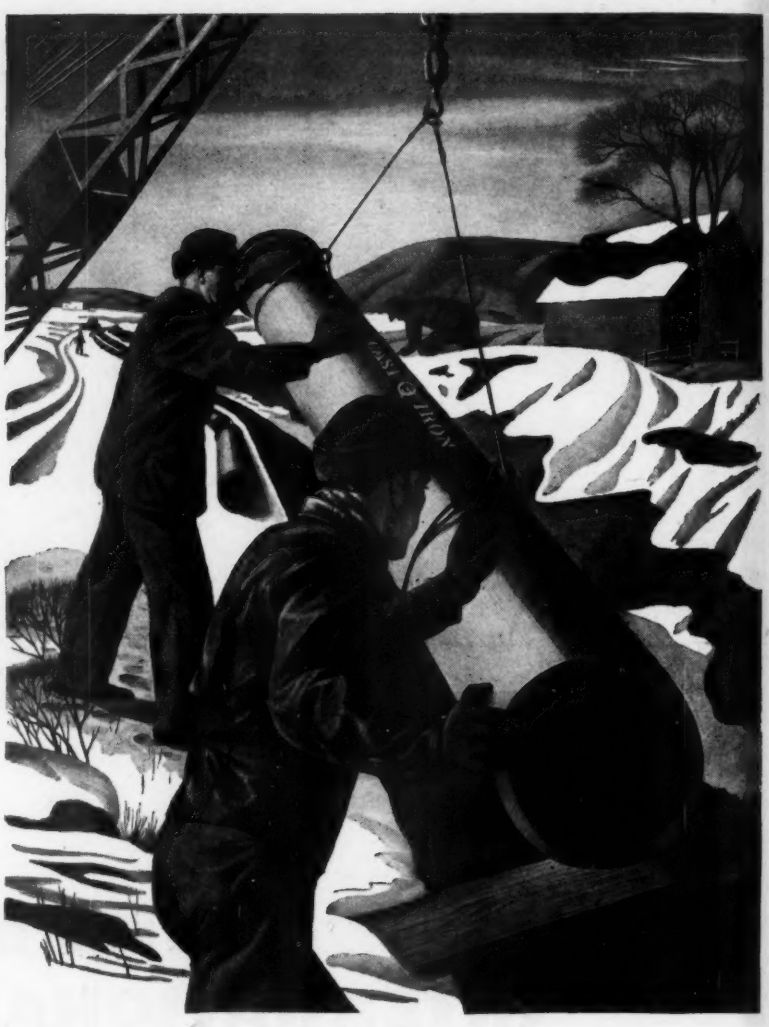

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Where headroom is limited—where you have to "duck" under an intersection or railroad, for example—ARMCO Pipe-Arches offer an ideal solution. Like other types of ARMCO Asbestos-Bonded Sewer Pipe, these arches are strong, light in weight, easy to handle, and assure years of low-cost trouble-free service.

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ARMCO

Armco Asbestos-Bonded Sewer Pipe

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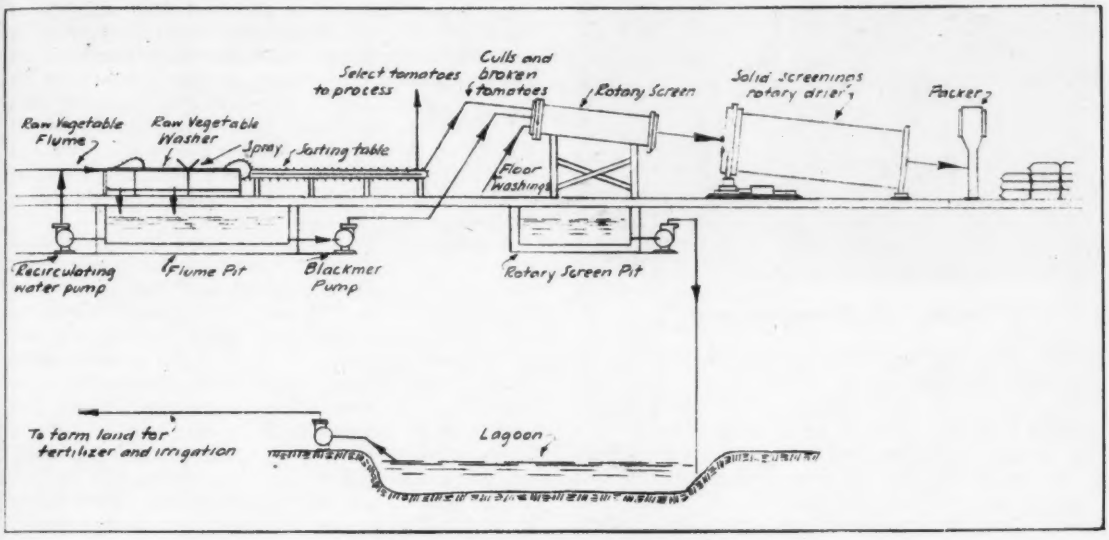


Flowsheet of cannery waste treatment plant.

Cannery Waste: An Example of Complete Treatment and Disposal

Wastes from a tomato canning plant were disposed of at reasonable cost and without interference with canning operations

By LEWIS B. MILLER*

Associate Professor, Department of Chemical Engineering University of Cincinnati, Cincinnati, Ohio.

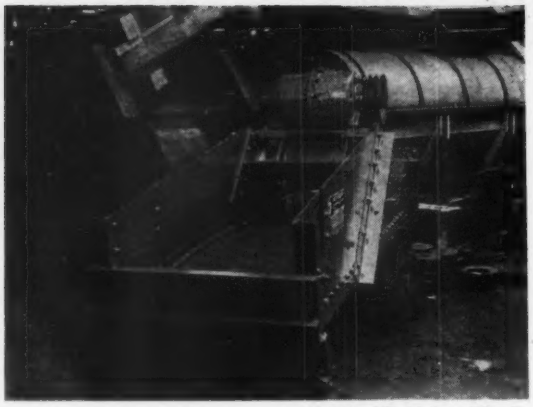
SERIOUS pollution of a small creek arose through the discharge to it of cannery wastes from the canning of tomatoes. At the request of the cannery owners an investigation was made of the characteristics of the wastes derived from the several steps of the canning operations with the objective of providing adequate treatment for reducing the pollution load discharged to the creek. An effective and practical system of treatment of the wastes and disposal of residual materials was developed.

Description of Wastes

The raw tomatoes are brought from storage to the cannery proper by means of an open water flume. This flume delivers the tomatoes to washers where they are subjected to thorough washing with fresh chlorinated well water in suitable washing machines by means of pressure water sprays. The washing machine water, which includes both the recirculating water used in transporting the tomatoes from storage to process and the water used in the washing machine sprays, is discharged to a large concrete basin designated as the "flume pit." From the washing machines, the tomatoes pass over sorting tables where they are sorted by hand. Rotted fruits or fruits unsuitable for canning are discarded at this point. Decayed spots are cut out of otherwise suitable tomatoes and the decayed portions discarded. The rejected product from the sorting tables, as well as that portion of the tomatoes which is broken up in the washers, together with refuse washed from the surface of the tomatoes, enters the flume pit. The flume pit water is, therefore, highly polluting in character.

In the flume pit, a portion of the solid materials sinks to the bottom of the pit, a portion floats on the water surface, and a portion is dispersed through the fluid portion of the flume pit water. Samples for laboratory analysis were taken from the frothy upper layer in the flume pit, from the fluid middle layer, and from the solids collected in the bottom of the pit. Composites of the wastes being discharged to the stream during normal operations of the day shift and of the wastes being discharged during wash-up time at the end of the day's operations were collected and analyzed. Wash water from the cannery floor, taken during the wash-up period at the end

*The work on this project was done while the author was associated with the firm of W. H. & L. D. Betz, Consulting Engineers, Philadelphia.



Courtesy Allis-Chalmers Mfg. Co.

Vibrating screen for separating solids.

of the day, was likewise analyzed. The results are presented in Table No. 1.

The analytical results indicate that the waste waters, derived from the different parts of the cannery during normal operations and as a result of wash-up at the end of the day, all contain large quantities of organic materials and are, therefore, all highly polluting. The cannery operations were then studied from the viewpoint of so altering existing operations that pollution of the adjacent stream would be reduced to a minimum or, preferably, completely eliminated with a minimum change in operating procedure and with a minimum expenditure for a waste treatment system.

Description of Waste Treatment

A flow sheet of the waste treatment system developed and its relation to the cannery operations is shown herewith and the procedures utilized in handling the waste materials without interference with routine plant operation are described below.

Process water is obtained from deep wells and is chlorinated. This water is used in the sprays for the washing operation on the raw tomatoes and is then discharged from the washing machines to the flume pit. The flume water which conveys the raw tomatoes from storage to process is likewise discharged into the washing machines and thence into the flume pit. The flume pit water is recirculated back to the raw tomato storage by means of a centrifugal pump where it is again used for conveying the tomatoes from storage to process by gravity flow. Make-up water is supplied to the recirculating system by the sprays on the washing machines. Waste water is withdrawn from the flume pit by a float-controlled Blackmer pump, which was selected because of its ability to convey the broken and spoiled tomatoes from the flume pit to a rotary screen with a minimum of breakage of the tomatoes. At the rotary screen (which was already available) the larger solid particles are screened out and conveyed to a rotary dryer, following which the dried material is packed and sold as a stock food. Culls from the washers are also screened and dried in this dryer. The floor washings from the main cannery building are also sent by gravity to the rotary screen for the salvage of whatever solids can be extracted by the screening operation.

The liquid fraction from all of these sources passes through the rotary screen and is collected in a pit located under the rotary screen. At the end of a day's operations, the flume pit is emptied and then thoroughly washed, all of the wastes and wash water being passed through the rotary screen and to the collecting basin beneath.

A float-controlled centrifugal pump conveys the collected waste waters from the rotary screen pit to large lagoons located on the crest of a hill several hundred yards from the cannery. When the lagoons fill sufficiently to require it, the waste waters that have not percolated away through the soil are pumped over the crest of the hill (in the direction away from the cannery) and are distributed to farm land on the side of the hill by means of a suitable system of pipes and pressure hose. There the wastes are utilized for their fertilizing value and to some extent for irrigation purposes during the dry season of the year.

Fortunately, the lagoons could be located at some distance from the cannery and from the nearest dwellings so that possible nuisance conditions from odors developing at the lagoons will probably never be serious. Provision has been made, nevertheless, for treating the lagoons according to the method developed by the National Canners Association for odor reduction. This consists of treating the lagoons with a solution of sodium nitrate in amounts proportional to the volume and biochemical oxygen demand of the wastes present in the lagoons as determined by test. In the present case, such treatment can be effectively made by dissolving the so-called agricultural quality nitrate in the rotary screen pit and pumping the solution to the lagoons. Any excess nitrate present will add to the fertilizer value of the lagoon wastes when they are subsequently pumped to the adjoining farm land.

TABLE I-- Analyses of Cannery Wastes

	Flume Pit Water Top	Middle	Bottom	Composite of Waste Normal Day	Wash-up	Floor Wash Water
Turbidity (SiO_2)	592	408	...	408	756	592
BOD	1920	1180	10,080	1020	1980	3140
Total Hardness ($CaCO_3$)	...	680	...	...	...	...
P. Alk. ($CaCO_3$)	...	0	...	...	...	...
MO Alk. "	...	325	...	...	...	...
Sulfate (SO_4)	...	580	...	...	...	...
Chloride (Cl)	...	39	...	...	...	...
Apparent Color	350	280	...	300	280	200
pH	4.8	4.7	...	4.9	4.6	4.5
Total Solids (PPM)	2952	2302	...	1968	3190	6458
Total Vol. "	1626	1106	...	884	1752	4010
Set. Vol. "	724	92	...	48	310	1188
Set. Sol. (cc/liter)	190	72	1000	1.5	230	130
Susp. " (PPM)	1332	682	...	414	1736	3084
Susp. Vol. "	844	368	...	206	1004	2306
Oxygen Consumed as O	660	230	...	140	405	785

Use of Lagoon Waters for Increasing Soil Fertility

As indicated in an earlier paragraph, disposal of the liquid wastes from the lagoons was provided by pumping these to adjacent farm land for the purpose of supplying moisture to the land and fertilizer to the soil. Several factors favored this method of ultimate disposal:

1. Studies extending over a period of years (1) have demonstrated that cannery wastes, such as tomato wastes, can be disposed of in this manner if the soil is light and porous in character. Reference to soil surveys made by the U. S. Department of Agriculture indicated that the soil in question was a Podzolic loam and therefore of a suitable type for this usage. It was recommended that irrigation of the soil by the cannery wastes be limited to 40,000 gallons per acre and that treatment be made not oftener than once per week. (2) (3). It was further recommended that the soil be limed with very finely pulverized limestone to the extent of

(Continued on page 43)

Making City Streets Adequate for the Traffic Load

A discussion of the problems of modernizing streets to meet today's traffic conditions, abstracted from a paper before the League of Wisconsin Municipalities

By JAMES R. LAW
Chairman, Wisconsin State Highway Commission

THE load that urban streets must bear now, and for their service life, depends on the number of motor vehicles, both present and future. In 1916, with a population of about 2,500,000, there were 125,000 motor vehicles registered in Wisconsin. On the basis of opinion at that time, it was predicted that by 1926 there would be a registration of 275,000 motor vehicles in the state, and that a saturation point would be reached in or about 1926. As a matter of fact, there was a total registration of 666,000 motor vehicles in 1926. Today there are 900,000 motor vehicles registered in Wisconsin. Similar attempts to predict prescribed limits for future automotive and aeronautic development would undoubtedly prove equally fallacious.

The need for adequate highways between points of population pushed the rural program to the extent that rural main roads largely became of better quality than city streets. All during the thirties, and up to the years just before the war, our street conditions were poor. Streets are much worse today. True, there are fewer automobiles—wearout has exceeded replacement—but those vehicles remaining are receiving much more intensive use. This is evidenced by the increasing receipts of gasoline tax.

The concentration of people with automobiles and trucks in urban sections during and following the war represents that much more concentration of use of city streets. Even the people without vehicles call for more use of the streets by the bus and taxi services demanded by those people for access to their work.

There are ways to approach the problem of improving the streets and the traffic facilities of the cities, but the apparent solution is not always the effective solution. For instance, with the increase in motor vehicles, Los Angeles determined that its major problem was in handling traffic. It spent 275 million dollars widening streets to the central downtown area. That brought the cars downtown all right, but there was no place for them to stop. Business dropped off; property values decreased. Los Angeles was in a worse snarl than it was before. From this experience we know that simple street widening alone is not the answer.

There are other ways to solve the urban problem of heavy traffic. Let us examine a few.

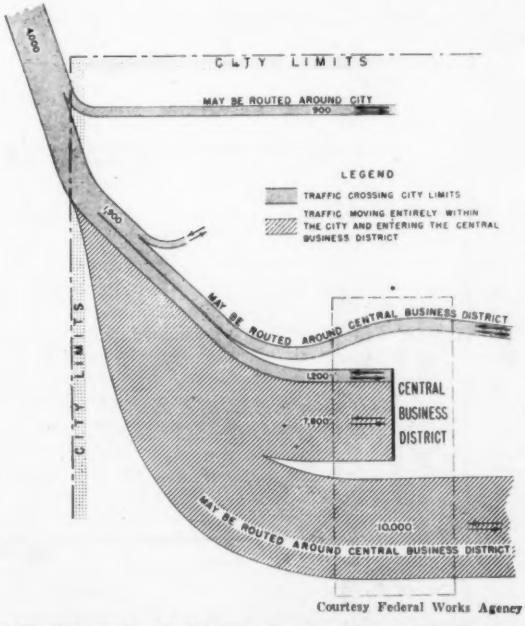
(1) *Limited access, modern, elevated or depressed highways.* St. Louis has its depressed boulevard—New York has the depressed Henry Hudson Parkway and the elevated Gowanus Parkway. Chicago has its Outer Drive. That costs money—from ¾ to 2 million dollars a mile. In all Wisconsin, that type of solution is sound probably only in Milwaukee, and Milwaukee officials are presently studying their problem.

(2) *Belt lines to skirt the urban areas.* Before the war, the thinking of the Public Roads Administration, and highway officials in general, favored the building of wide traffic belts around the cities—the farther out, the better. Those already built show an error in such thinking. It seems that most of the traffic approaching a city has its desired destination somewhere in the city—not a point beyond it.

We at the highway commission have just completed an origin-destination survey at Lancaster. Our interviews show that a majority of the people questioned on the highways leading to Lancaster wanted to get into Lancaster—not to the other side of it. Only 29 per cent of the traffic would use the full length of the by-pass if it were provided. A by-pass would remove only 343 vehicles per day from the traffic around the courthouse in Lancaster. Reduced to hourly volumes, the measure of relief is not particularly significant.

The thought on belt lines today is to build them, but to locate them closer in so that they will provide a route from one part of the city to the other, as well as accommodate the through traffic. They must provide for local use as well as for the passing tourist so as to warrant the expense involved.

(3) *Improvements on local streets.* While a street widening program may not always be as disastrous as it was in Los Angeles, city officials should examine their proposed plans with a critical eye. Surely widening for the purpose of providing parking is not the answer. The street is probably the most expensive spot



Courtesy Federal Works Agency

Traffic that may be diverted around a city and around the business district, based on cities of 50,000 to 100,000 population.

to park that could be provided. Considering land value and the cost of present-day highways, the car that parks on a business street may be occupying space that costs from three to five times the purchase price of the vehicle that covers it.

The adequate regulation of traffic may be fully as effective as the provision of more space for traffic. It is obvious that one-way traffic will provide a more efficient utilization of space. Similarly, the prohibition of left turns can increase the street capacity in the same way that a rural cloverleaf can handle more traffic than a simple intersection.

Parking Problems

I spoke of the cost of parking on the street. The congestion and slowing down of traffic caused by street parking is another problem.

Since, in most cities, only a very small percentage of the total cars are parked at the curb, the installation of parking meters cannot possibly be the entire answer to the parking problem. There is, however, a distinct possibility that the number of motorists served during the shopping hours can be doubled, tripled or perhaps quadrupled. Until off-street parking areas can be made available and other measures taken to provide parking for the shopping public, the installation of parking meters appears to be one of the important emergency steps which can be taken. The revenue derived from parking meters should be used for the purpose of traffic regulation and for financing off-street parking facilities.

Who will pay the cost of off-street parking facilities is a problem facing city planners over the nation. The cost of providing such facilities varies. Actual figures given by cities which have provided large off-street parking areas range from $500 to more than $1,000 per vehicle space.

Four major groups benefit from such facilities. Probably the most equitable formula for spreading the cost would be one which assigns each of these groups some participation in the cost. These benefited groups are:

(1) Property owners and business institutions in the central business districts. If property values depreciate because of decentralization then the property owners and those doing business there suffer direct losses.

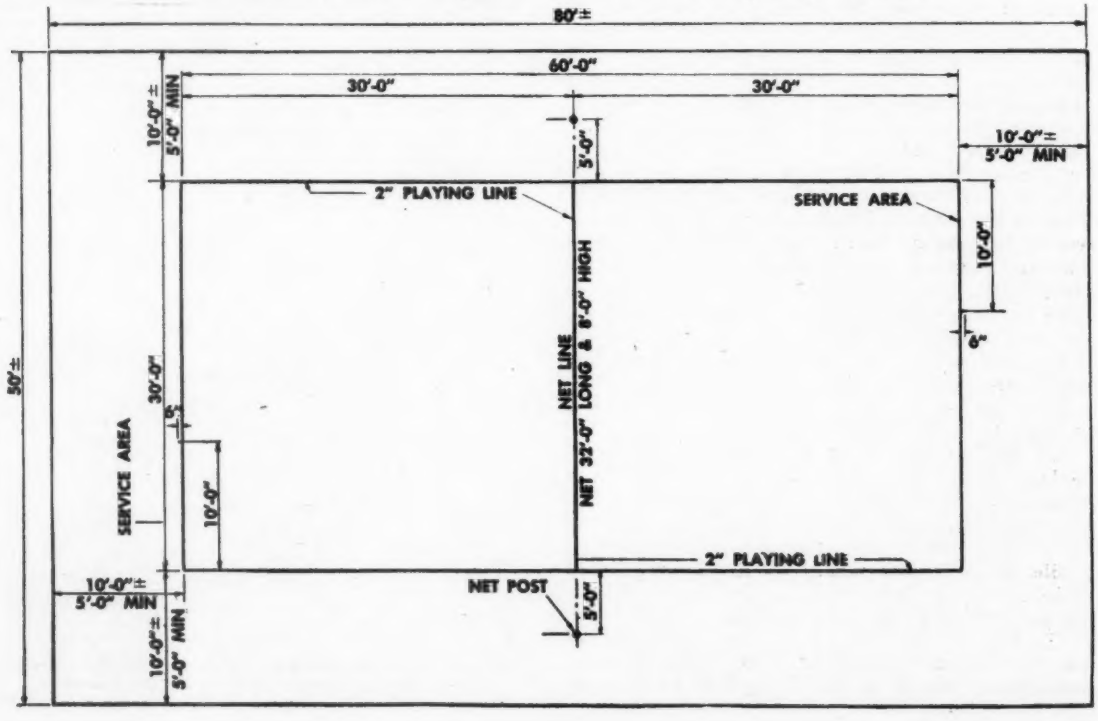
(2) All taxpayers in the city, since in the average city the central business district occupies only about 2 per cent of the area of the city but pays from 25 to 30 per cent of all the taxes in the city. In the typical community, few, if any, of the residential wards pay enough in taxes to cover the cost of services rendered by the city. The balance is made up from taxes collected in the central business district and the industrial areas. If the downtown areas are lost, that loss must be passed on to the owners of property in other areas. This re-shuffling of the tax load may be slow in making itself felt, but that shift must come with decentralization.

(3) The users of parking space in the central business district. Those who create the parking problems must pay the toll.

(4) The municipality itself, since it has a great investment in the central district which it must protect, as well as conserve the high valuation in that district which pays such a large part of the operating costs of the municipality.

Some parking plans now being operated successfully assess all the costs against one or more of these four groups. No matter what way the solution turns, there will be pressure against it by individuals and by more powerful groups. City officials must take a firm stand, backed by a knowledge of all aspects of the problem and by a weighing of all proposals, for the correction of an awkward situation.

Athletic Field Layouts—A Volleyball Court



Pump Houses for Deep Well Water Supplies

Getting an attractive building; landscaping; laying out the floor plan; practical information on what to do and how to do it.

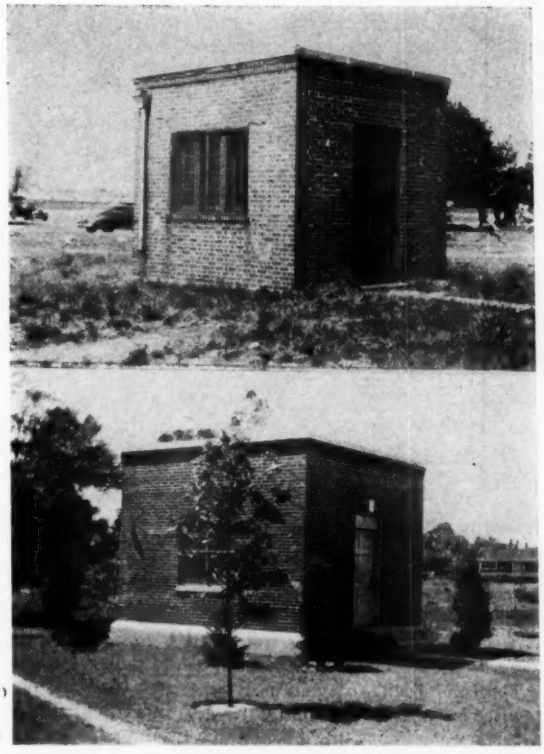
By FRANK E. HARLEY
Harley & Garlick, Consulting Engineers

AFTER a well installation is completed, it is desirable to provide proper housing; and it is not amiss to beautify and landscape the well house site, particularly if it is in a residential district. The cost of a good looking, substantial, fire-proof pump house should not exceed from 20 to 35% of the total installation cost. It will vary between these figures depending on how elaborate a building is constructed and how much landscaping and planting is required.

The building must be substantially constructed, of ample size to house all the auxiliary equipment, such as chlorinator, automatic panel board and metering devices, provide a small space for the operator's desk and chair, and room to store tools out of sight. It should be of solid brick construction or of cinder block with brick or stone facing, with a substantial roof, preferably of concrete with Barrett or similar roofing material. The top coping and the brick walls should be properly waterproofed, and the walls and roof heavy enough to provide for the exceptionally heavy loads they are called on to carry from time to time, in installing the pump, pulling the screen and in repairing and replacing the pump. This load is generally carried on the roof and in designing the building it should be taken into consideration.

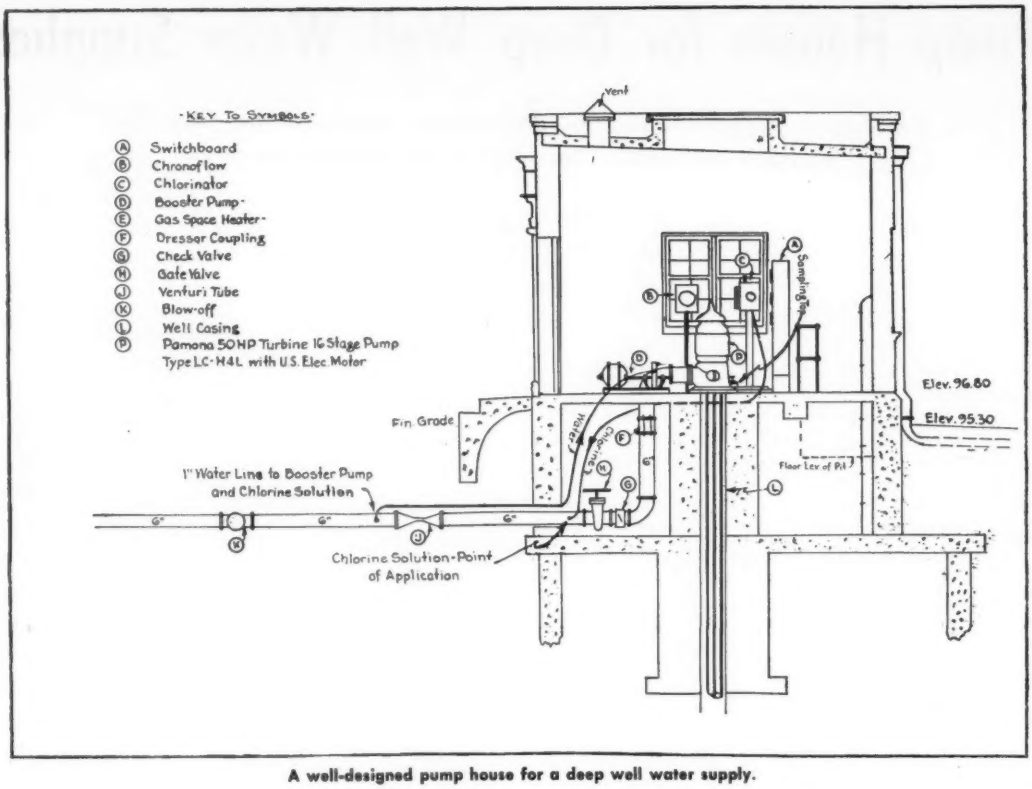
The pump floor should, of course, be of concrete, and if a pit or cellar is underneath, the floor should be heavy enough to stand the load of a tripod pulling a stuck pump with maybe 3 to 5 tons or more of pump, column, shaft, turbine and tail.

Recently the writer had occasion to build a new pump house, 14′ x 14′ inside, placed over an old pump house foundation about 15 ft. below grade. The old well had been cleaned, deepened and developed, and this well naturally was in the center of the old pump house. As it was necessary either to carry the new foundation walls down about 15 ft. or slab over the old foundation walls 6 ft. below grade, it was decided to construct a very heavy reinforced slab over the old walls and carry the weight of the entire new building on this slab. This made it necessary to put a 7-ft. "cellar" under the pump floor. The pump foundation was carried down to the old floor level and the supporting slab on the old walls was partly supported by this pump foundation. This made it convenient to carry all piping, wiring and control lines in the cellar and hang them on the cellar ceiling. Then through previously cored holes in the pump floor they were led direct to each piece of equipment. The meter board and gas meter were placed in the cellar, and access was had by a steel rung ladder bolted to the wall. This cellar was well lighted electrically and it is possible to make all pump connections "below" deck with ease. This cellar also eliminated the usual pit for the pump discharge line and resulted in a clean looking pump house floor without any heavy steel floor plates to lift up when servicing the pump line. Frank Knapp, Sup't. of the Fair Lawn Water Works, had found by previous experience in the main pumping station that by dropping the scale and chlorine tank about 3 ft. below the pump house floor, he eliminated "freezing" in the chlorine line. In this building the chlorine scale was placed about 3 ft. below the main floor for this reason. The experience with this "cellared" pump house, indicated that the advantages are fully worth the small additional cost.



The lower view shows the better design job done by the architect.

While the engineer laying out the pump house knows just how he wants the interior, it is advisable, in order to add the touch of real craftsmanship to the building, to have a very capable architect design the exterior, and let the engineer worry about the interior. The evolution from an engineer designed building is shown in the accompanying illustration. The building shown above in the illustration is for utility only and does not add to the attractiveness of the surroundings. Also by not waterproofing the brick work, the frost has penetrated into the brick each year and is causing spalling. This building was given careful study by the architect and was touched up by the addition of more woodwork around the door and the keystone over the door. These pictures are furnished through the courtesy of the Fair Lawn Water Dep't., Frank



A well-designed pump house for a deep well water supply.

Knapp, Sup't., Jacob H. Schultz, Jr., Water Commissioner and Theodore K. Ferry, Mayor.

After a well constructed, well designed building is completed, the grounds surrounding this building should be landscaped and seeded into lawns, with perhaps a flower bed or two, with some shrubbery to set the building off. Trees add much to the appearance. The constituents of your boss or Water Commissioner will rise up and call him "blessed" instead of raising "merry hell" in the Council some evening for putting an eyesore in their neighborhood.

In designing the building, proper ventilation should be provided, the building well insulated and made weather-tight. It is advisable to provide either double glazed sash or double windows, to keep out the cold. Heavy metal screens are desirable to prevent vandalism, with provision for flood lighting the building.

Heating should receive consideration, particularly where there is mercury in the meters and where chlorination is employed. Also the water connections to the automatic control must be protected against freezing. In a number of well houses an electric heater was used, but these proved very costly and unsatisfactory. In later buildings, gas heaters automatically controlled were used, with very satisfactory results both from the heating and cost standpoints.

In writing pump house specifications, the architect will furnish his general building detail specifications, but it is necessary for the engineer to supplement this as to other portions of work to be included. The grading, landscaping and trees may be furnished by the building contractor; or may be by a separate contract. In the latter case, how far must the building contractor carry grading operations, particularly in disposing of his excess excavation? This must be clearly stated in the specifications. It is generally easier to include all this work in the building contract, as this eliminates causes for dispute and generally results in getting a better looking job. As the pump contractor will be generally installing equipment during the construction of the building, particularly in the floor, the work of each of these contractors must be clearly stated. Will the pump contractor furnish all the power wiring from the meter board? Will the building contractor furnish just the building lighting and heating circuits, from a designated point on the meter board? It is generally advisable to make the pump contractor furnish all wiring from the delivery point of the lighting company, the meter board, all power wiring, cable, conduits, conduit for the meter or chronoflow line, and the power transformer and hook this up to the point of delivery of the house circuits. In addition, there are many operations the Water Department may desire to do itself. Provision must be made in the contracts to have each contractor furnish full access to each other's work and to the Department and to lay all necessary control lines, pipes, conduits. By clearly defining each other's work, many hours of argument and perhaps suits in the courts will be avoided.

In regard to the size of the pump house, it is advisable to provide sufficient room around each piece of equipment to work properly and safely, and to not require the dismantling of the chlorinator, meter board or panel board to get the pump out. Also, it is very essential to see that the door is large enough to handle the largest piece of equipment that will be used. It is far better to lay the proposed equipment out to scale on a floor plan, with all the supplementary equipment, and find out just how much space is needed, than to try to crowd it in after the building contract is let. From experience, a minimum of 12′ x 12′ inside, where there is no automatic equipment and at least 14′ x 14′ with automatic equipment is the minimum desirable.

Sewage Treatment to Destroy Infantile Paralysis Virus and Remove Eggs of Intestinal Parasites

South Africa studies sand filtration of sewage in order to remove or destroy ova or cysts causing amebic dysentery, hook worm and similar diseases.

IN the urban areas of South Africa there are 1,750,000 Europeans and 2,000,000 non-Europeans. Most of the latter are infected with amebic dysentery, round worm, tape worm and hook worm; and most of the European children living on mining properties are infected with the round worm, eggs of which have been found in the percolating filter effluent used for irrigating vegetables used for salads. Realizing the risk of transmission of these diseases due to sewage disposal works, the city council of Johannesburg decided to study the problem with a view to ascertaining just what the initial risks in sewage were, and how far sewage purification plants would eliminate the risks.

Over a whole year, samples from the five Johannesburg sewage works were taken and submitted to the bacteriological and parasitological departments of the South African Institute for Medical Research. The results have been summarized in a report (not yet released) to the Union Health Department. The investigation is being continued but the following conclusions are definitely established:

1. That the cysts of Entamœba Histolytica (amœbic dysentery) and eggs of Ascaris Lumbricoides (round worm), Tænia Saginata (tape worm) and Ankylestoma (hook worm) are frequently present in Johannesburg sewage as it arrives at the works.

2. That cysts or eggs have been found in screened sewage, settled sewage, primary filter effluent and humus tank effluent, and also in the effluent from activated sludge plants.

3. That in the samples examined, no eggs, ova or cysts were found to have passed secondary sand filters (ordinary and Hamlin reversible types) or underdrained land filtration areas.

In 1945 eight cases of infantile paralysis occurred in a suburb of Johannesburg, sewage from which was treated in that city's Cydna plant. As no method of detecting the virus of this paralysis was known, monkeys were injected with screened sewage, settled sewage and humus tank effluent from the Cydna plant and all developed paralysis; but one monkey injected with sand filter effluent did not.

E. J. Hamlin, City Engineer of Johannesburg, recently elected president of the Institute of Sewage Purification, in a paper before that Institute November 21st, 1946, (from which this information is condensed), commenting on the above, said: "This work establishes (1) that the infantile paralysis virus may be present in sewage from areas where cases have occurred, and (2) that the virus may be removed by suitably extensive treatment. . . . The result of these researches appears to indicate that, so far as South Africa is concerned, the value of the secondary sand filter is brought into prominence. It is likely that in South Africa the slow sand filter will in future be a compulsory adjunct to any sewage works from which the effluent is to be discharged into a stream, or is to be used for irrigation on land on which crops for human consumption may be grown."

The type of sand filter used by Johannesburg is known as the "Hamlin reversible sand filter" and is described by Mr. Hamlin as follows: "It is a reversible type of sand filter, first built by C. H. Hamlin, late sewage works manager at Luton (England). The object of the filter is to serve the dual purpose of a humus tank and sand filter.

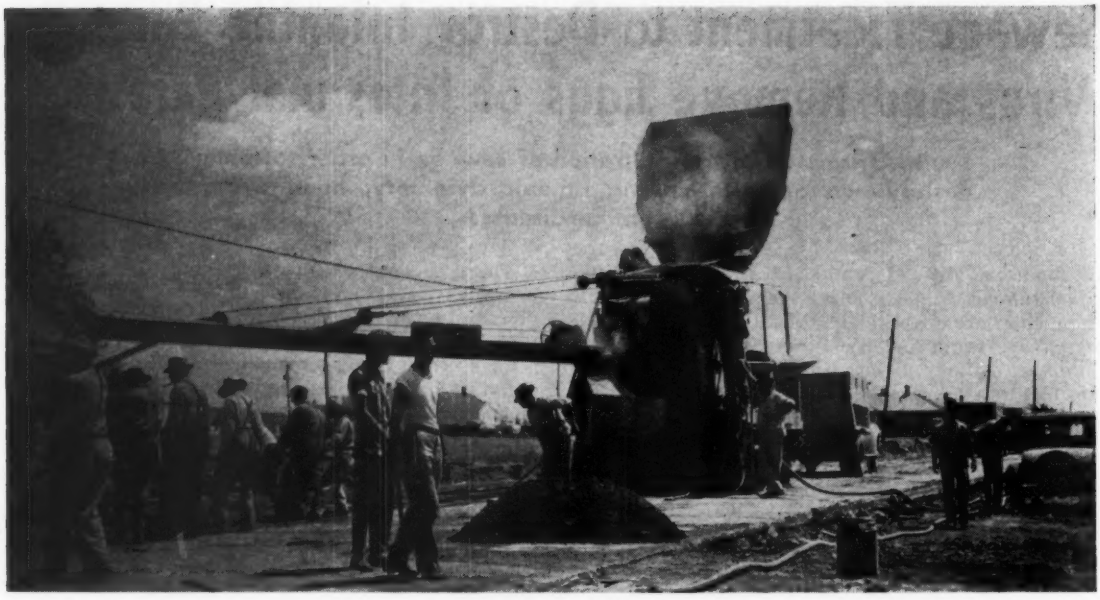
"Even after primary effluent has been passed through humus tanks, we have found that it is still desirable to pass the humus tank effluent through sand filters. It is clear, therefore, that if a filter combining the duties of a humus tank and sand filter could be evolved to meet South African conditions, considerable savings could be effected in the cost of treatment works.

"Primary effluent is supplied to the filter by means of a central channel which runs the length of the bed. The top of this channel is at the same level as the medium. From this central supply channel the effluent spills evenly over the surface of the filter. After passing through the medium, the filtered effluent is collected in two channels constructed at a lower level, but adjacent to the central supply channel, and thence either to land or, as at the Klipspruit works, on to watercress beds and then to the dam at the new municipal power station, where the effluent is used to make up the cooling water for the condensers.

"By means of suitable valve arrangements, it is possible to drain the water in the filter down to medium level, or to empty the bed completely. Having done this, filtered effluent from adjacent filters—the water level in which is 3" higher than medium level—can be brought back and passed through the filter from underneath the medium. Actually the filter could be operated either as an ordinary upward or downward flow filter, but for the present it is operated on similar lines to the experimental one at Luton, i.e. as follows:

"Primary filter bed effluent is supplied to the filter, and the humus in the effluent is deposited on the surface of the filter, the water passing through the sand into the collection channels and thence to cress beds or land. When the filter is drained, the humus is left on the surface of the sand, and by reversing the feeding effluent from the bottom, the humus is lifted, washed back into the supply channel, and thence into the sludge main. The whole of the above operation could be reversed, i.e. primary effluent could be fed from the bottom, in which case the humus would be retained below the layer of fine medium, and, by reversing the flow, the humus could be washed out via the underdrains into the sludge drains.

"As in the case of the experimental Luton filter, provision is made for disturbing the settled humus by means of squeegees. These are hung from the transporter carriage which runs in the channel guides built into the filter walls. By moving the squeegees at a brisk pace across the sand, it is found that a small wave is set up in front of the squeegees, and the humus is lifted and carried away into the channel leading to the humus draw-off pipe."



Reconstructing and widening Central Avenue.

Street System Inventory—Wichita, Kansas

How Wichita is preserving its $16,000,000 investment in street pavements through a long-range, comprehensive plan based on a street system inventory.

By **EUGENE N. SMITH**
Director of Service

THE war period caught Wichita "off-base" as it did many other cities in the country. The few years between depression and war were insufficient to permit catching up on a street maintenance and reconstruction program which was ten years behind, in spite of leaf-raking and WPA. After the attack on Pearl Harbor, street maintenance was shoved farther and farther to the background in favor of projects directly concerned with the prosecution of the war.

During the Winter of 1943-1944, the late Paul L. Brockway, then City Engineer and Director of Service, realized that some move must be made to preserve the City's investment of about 16 million dollars in its street pavements which, in many cases, were rapidly depreciating due to long deferred maintenance and also due to the increased impact of war conditions. He realized that annual budgets of $8,000 or less during the depression years had provided no material improvements and that State highways within the City's limits required $100 per mile per year for maintenance. Accordingly, Mr. Brockway determined to do something and, as a first step, began a survey of the physical condition of every block of paving which involved 271 miles.

He personally drove over every paved street in the city, making field notes of the then current condition of each pavement, recording needed repairs, heavier maintenance, necessary construction or reconstruction. The survey included details such as base failures, surface conditions, riding qualities, drainage and structures, needed repairs for curb, gutters and bus stops, removal of abandoned street car tracks and ties, intersections where radii should be increased, and streets where traffic volume indicated increased pavement or right-of-way widths. In addition, the survey included Mr. Brockway's opinion of unpaved streets which should be paved and those which should be opened or

Surface treatment with RC-3 and chats.

right-of-way acquired. Notations were made of pavements considered as satisfactory.

In addition to evaluating and analyzing the field notes, the office work included the preparation of the following:

1. Explanation of the survey
2. Brief history of all types of paving in the city
3. Maps and graphs
4. Explanation of the major street system
5. Description of proposed relocation of U. S. Highway 54
6. Description of proposed alternate U. S. 81 truck by-pass
7. Program for financing the improvements over a ten-year period
8. Exhibits:
   - A. Improvement program for streets on highway routes
   - B. Improvement program for major streets
   - C. Improvement program for other streets needing special attention
   - D. Improvement program for secondary streets.

All exhibits contained two columns, one headed "Maintenance" and the other, "Construction and Reconstruction." Streets were listed alphabetically. Each street or portion thereof had a brief description of the recommended repairs or improvements, together with an estimate of cost. Each item was given a priority: (1) Urgent; (2) Necessary; or (3) Desirable. Additional comments such as year constructed, type of pavement, whether cost should be assessed or paid by City at large, and other pertinent information were also included. Some alleys, but not all, were included. The report contemplated a ten-year period of improvements. The summary sheet shows that, in addition to the usual work done resulting from petitions, Wichita should spend $3,186,000 during the ten years for new construction and reconstruction, all of which would be financed by bonds, and that $41,300 should be spent annually for maintenance and would be financed out of the Street Division operating funds. The comprehensive inventory contained 60 sheets of 8 ½" x 11" paper and was indexed and bound in loose leaf folders for convenience.

The City Commission approved the report and promised the necessary funds. Action on the recommended improvements contained in the report was started in 1945 and continued in 1946. Every effort is being made to keep the inventory current which often involves a change in the priority and naturally an increase in the estimates. Since 1945 was a war year, the program for that year was naturally considerably curtailed. However, about $100,000 was spent on reconstruction and $20,000 on surface treatment, patch work and crack filling. This year the program has been stepped-up considerably, and approximately $374,000 has been spent on reconstruction and $67,000 on maintenance. In addition to the foregoing, during 1946 we have constructed paving on heretofore unpaved streets, amounting to approximately $350,000.

During the war, Wichita increased 40% in population. Since V-J Day, housing construction has developed in both old and new additions, causing a demand for new pavement which will affect the amount of reconstruction which can be done. Manpower and equipment has been, and probably will be, somewhat of a handicap but we are hopeful that conditions in these fields will improve to the extent that the program can be maintained. Although only 14% of the original program has been completed, a decided improvement can be seen in our streets. Plans are now under way in the Engineering Division for some of the major reconstruction and widening projects that are contemplated for 1947.

Experience has already shown that the street inventory is a logical approach to the problem of maintenance, an excellent work guide for the various divisions concerned, and a desirable tool for the administrator.

EXHIBIT B

MAJOR STREET MAINTENANCE AND CONSTRUCTION

1. Indicates that work is urgent.
2. Indicates that work is necessary.
3. Indicates that work is desirable.

Maintenance		Construction and Reconstruction	
Pawnee, Hydraulic to Broadway - 40 ft. road.			
1. Surface treat every third year	$300.00	2. Present pavement on grade that cannot be used in city development. Pave 40 ft. wide after being brought to grade. Some special drainage structures will be necessary.	
Repair annually	1,200.00		
Average	1,500.00 yr.	Cost	$55,000.00
Maintenance possibly good for 6 years.			
Harry, East of Canal - 30 ft. road.			
1. Surface treat each third year	400.00	3. Reconstruction can be deferred indefinitely if maintenance is done.	
Patch each year	400.00		
Average annual	850.00		
Harry, Canal to Broadway - 30 ft. except Water to Laura widened to 46 ft.			
2. Crack maintenance	150.00	Defer new construction indefinitely.	
Harry, Broadway to Arkansas River - 30 ft.			
1. Surface treat each year	500.00	1. Retread not later than 1946	7,000.00
Kellogg - Special Report - Relocate 54.			
Waterman, Washington to Hydraulic - 40 ft. wide - O. K.			

A sample sheet, showing how each street was reported on.

SUMMARY - CONSTRUCTION

Urgent:	
Highway construction	$850,000.00
Major street construction	45,000.00
Other principal streets	22,000.00
Total	917,000.00
Necessary and may become urgent at any time:	
Major streets	1,165,000.00
Other principal streets	187,000.00
Total	1,352,000.00
Desirable development of street system:	
Major streets	822,000.00
Other principal streets	95,000.00
Total	917,000.00
Note: Desirable improvements include $340,000.00 for new pavement on unpaved streets and $290,000.00 for the widening of major streets on which a pavement is now too narrow.	
Grand total	3,186,000.00

SUMMARY - MAINTENANCE

Urgent	
Major streets - annual	18,000.00
Other principal streets - annual	4,000.00
Secondary streets - annual	10,000.00
Necessary maintenance:	
Major streets and other principal streets - average annual - 5 years	4,300.00
Ordinary crack filling, patching, etc.	5,000.00
Total	41,300.00
After the first five years, it is estimated that Item 2 will not need to be repeated for another five or ten year period which will reduce the grand annual cost of the second five years to	37,000.00

The summary shows needed construction and annual maintenance costs.

Inventory and Stock Control for City and County Public Works Departments

Second installment of paper presented at a recent meeting of the British Institute of Sewage Purification.

By W. F. FREEBORN and A. A. KIRKBRIGHT
West Middlesex Main Drainage Works

Accounting and Indexing

The documents which the storekeeper handles (delivery notes, requisitions, etc.) form the basis of accounting and cost records, and must be kept as clean as practicable; and as he is required to handle a great variety of commodities, perhaps lamp-black at one minute and meter charts the next, he must of necessity be able to clean his hands very frequently. The provision in the store of washing facilities with hot and cold water is therefore very desirable.

To facilitate ready location of a particular item, each aisle should have a code letter, and each bin a number, and the front of each bin provided with a card holder containing a label showing boldly the description of the goods and the store code number. Great care must be taken in the compilation of the index, so that there is no confusion regarding the description, code number and location of any item. There should be ample cross-referencing, particularly of goods which are interchangeable but are differently numbered and catalogued by the various makers.

The indexing should be sufficiently detailed to enable authorized officers in the absence of the storekeeper readily to find the location of any particular material or part that may be required. Such entries into the store should, of course, only be permitted in an emergency.

It may not be inappropriate at this stage to mention the question of standardization in relation to spare parts. If in the planning of the new works the designer will plan boldly and decide the best make and type of plant (pumps, engines, etc.) suited to the job and keep to that make, both in the initial construction and any future extensions, then the value and multiplicity of spares which have to be carried in stock will be materially reduced. This will result in considerable saving both of storage capacity and of the amount of capital locked up; and will materially reduce time and clerical labor in connection with acquisition and issue.

When obtaining bids for equipment it is a good practice to require bidders at the same time to quote individually for a set of spare parts for those items which will require replacement from time to time. These will obviously not be firm for an indefinite period, as prices will fluctuate, but the manufacturer will be in a position subsequently to advise increases or decreases on a percentage basis, and the fairness of these can be gauged by general price trends.

Ordering Supplies

In recent years it has been realized that purchasing is a specialized job, and many authorities have established a centralized purchasing department. While such a department may prove useful in enabling a large number of standard products to be obtained at economic prices, special requirements may necessitate placing many orders outside the scope of central purchasing. Standing orders usually contain a provision that the lowest tender shall be accepted.

Where it is practicable to prepare a specification on which all parties must bid, this is a desirable feature, but countless things can be varied in quality to many degrees, and the lowest tender is frequently not the most favorable. As John Ruskin remarks: "There is hardly anything in the world that some man cannot make a little worse and sell a little cheaper, and the people who consider price only are this man's lawful prey."

By trade custom, certain craftsmen provide their own tools, and every station and workshop will, of course, be fitted up with a set of tools for every-day purposes, but special tools will be required on occasions, and precision instruments, gauges, etc., should be provided as part of the plant equipment. These tools and instruments are valuable and should be given into the custody of one person only. They should be tested periodically and maintained in perfect order, so as to avoid wastage due to the use of inaccurate instruments. The purchase of cheap tools and instruments is a wasteful procedure.

While the number of staff will naturally depend on the size of the store, the quality of personnel should be of the best. The important role of a storekeeper is slowly being recognized, but it is a regrettable fact that the status of many storekeepers is little higher than that of a laborer.

Finance

The primary object in the preparation of estimates is, of course, to fix the rate and to control expenditure. A careful examination of estimates reveals that, one community with an expenditure on operation (excluding interest and sinking fund items) exceeding $400,000 per annum can achieve this object with only 10 items, while another requires over 200 items. A large number of small items make much clerical work, but do not facilitate wise financial control or good management.

The number of officers and workers employed in a sewage works is not liable to great fluctuations, and, subject to wage rate variations, the expenditure thereon can usually be accurately forecast. Estimation of materials and services may be based on the analyses of expenditure in previous years, suitably adjusted to allow for fluctuating prices and any special work which it is intended to execute. Income under the various heads may likewise be forecast in the light of

(Continued on page 42)

How to Test the Performance of a Pump

Steps in determining the efficiency and capacity of your pump.

IN TESTING a pump, average normal operating conditions should be simulated as closely as possible, and when accurate instruments and measurements are employed, the error should not be over 3%. For making a test, the following data are required: Power input; total head; and rate of discharge of water. The first step is to test all instruments used in order to verify their accuracy.

Rate of Flow and Total Head

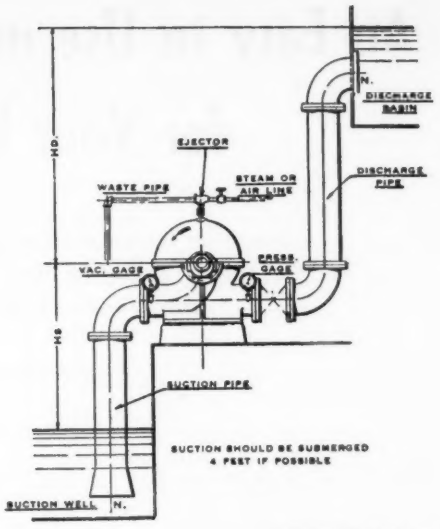
The rate of flow may be determined by a rate-of-flow meter, or a totalizing meter, or by measuring the water pumped into or taken out of a tank or reservoir. With a rate-of-flow meter, the pump discharge can be read directly from the meter dial. When a totalizing meter is used, the discharge over an accurately timed period can be used. In using a basin or tank, one must be selected where the gain or loss can be measured accurately; a reservoir with irregular shore lines and variably sloping sides is not suitable. A rectangular or circular tank with vertical walls is best. Hook gauges should be used in measuring changes in water level; a rule is not accurate enough for most conditions.

The total dynamic head developed by a pump is made up of the following: Static head, pipe friction, and velocity head at the end of the discharge line. The static head is the elevation between water levels at suction and discharge. The pipe friction in the suction and discharge lines increases the total head. Fittings in pipe lines are equivalent to added length of pipe. A gauge in the discharge line will indicate the pressure pumped against, which is the sum of discharge pipe friction, discharge velocity head and static head of the discharge pipe above the gauge. To obtain the total dynamic head, the height between the suction water level and the gauge, and the friction head in the suction line must be added.

Power Input Measurements

With an electric motor having an indicating or recording wattmeter, the power used can be read directly. If a watt-hour meter is available, both kilowatts and kilowatt-hours should be determined. Input may be read for the same period of time that the delivery of water is measured.

The actual power delivered by an internal combustion engine cannot be measured accurately. It is best to obtain the assistance of the engine manufacturer, if a precise check is desired, but an approximation of the power input can be computed by measuring the fuel consumed during the test, using small auxiliary fuel tanks or measuring the drop in level of fuel storage tanks, if this is accurate enough. With gasoline, a kilowatt-hour should be produced with 0.6 to 0.7 pounds of fuel; with diesel fuel, 0.55 to 0.65 pound will be required per kwh; and with gas, about 17,000 Btu. The Btu. per cubic foot of gas must be determined; it may range from 600 to 1,000.



Courtesy Allis-Chalmers

Pump layout showing suction and discharge heads.

Making the Computations

The kilowatt output of a pump is found by the following formula:

$$\text{Kw output} = \frac{\text{gals. per min.} \times \text{total head} \times 0.746}{3960}$$

in which 0.746 represents the number of kilowatts in one horsepower, and 3960 is the number of foot-gallons in one water horsepower. For example, assume 700 gpm., with a total dynamic head of 140 ft.; then,

$$\text{Kw output} = \frac{700 \times 140 \times 0.746 = 18.5}{3960}$$

The overall efficiency is computed as follows:

$$\text{Efficiency} = \frac{\text{kw output of pump} \times 100}{\text{kw input to motor}}$$

Assuming the kw output of the pump is 18.5, and the kw input to the motor is 25, the efficiency is $18.5 \times 100 \div 25 = 74\%$.

Rented Equipment is Covered by Contractor's Bond

The rental of equipment, leased to a general contractor constructing a sewerage system for a municipality, used to pump underground water from the sewer trench, and the value of missing leased equipment, were held to be within the coverage of the contractor's performance bond as "materials" furnished in the carrying forward, performing, or completion of the contract.

The expense incurred by the lessor of the equipment in furnishing a demonstrator to explain its operation was held to be a necessary operational incident to the work and also within the coverage of the bond. New Amsterdam Casualty Co. v. Moretrench Corporation, Virginia Supreme Court of Appeals, 25 S. E. 2d 74.

An Easy to Use on-the-Job Training Program for Your Highway Personnel

An outline for an on-the-job training program for state, county or city personnel, covering the elements of highway and street design, construction and maintenance. Second of a series.

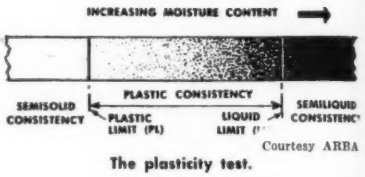
By the Editors of PUBLIC WORKS Magazine

VII—Soil Types and Classifications

General.—The most economical and available material for highway foundations is the local soil, and it is necessary to use this most advantageously. Present-day techniques provide methods of evaluating the suitability of soils for embankments and subbases; and permits engineers to control their moisture content and compact them so that they will furnish adequate support to the pavement.

Soil Types.—The following general types of soils exist: *Gravel,* the larger mineral grains, generally over ¼ in. in diameter; *sand,* mineral grains varying in size from ¼ in. for coarse sand to 0.002 in. or 0.05 mm. for very fine sand; *silt,* natural mineral grains varying in size from 0.002 in. (0.05 mm.) to 0.0002 in. (0.005 mm.); *clay,* the very fine particles smaller than 0.0002 in., or 0.005 mm.; *organic material,* partly decomposed vegetation, as in peats, or finely divided vegetable matter as in organic soils or clays.

Soil Classifications.—For engineering work, a more precise classification is necessary to distinguish the influence of each constituent as regards shrinkage, expansion, plasticity, absorption and permeability. The standard classification of the Public Roads Administration sets up eight groups, A-1 to A-8, inclusive, based on the characteristics important in subgrades. A-1 soils are well graded, contain excellent binder and have a high bearing capacity. A-2 soils are generally similar, but the grading or the binder are inferior. A-3 soils consist of coarse material only, without binder. A-4 soils are predominantly silt, with small amounts of coarse materials and clay. A-5 soils are generally the same as A-4, but inferior. A-6 soils are predominantly clay, with small amounts of coarse materials. A-7 soils are similar to A-6 but at certain moisture contents are elastic under load. The A-8 soils include the peats and mucks.



Courtesy ARBA

The plasticity test.

The Corps of Engineers, U. S. Army, uses a different classification, with group symbols. The gravels are indicated by G, with an accompanying letter, as GF for gravel with fines, corresponding generally to A-2 and A-3 soils. Similarly S is used for sands, C for clays, Pt for peat, O for organic soils and M for silts, each with various descriptive letters.

Each soil has fairly specific qualities as determined by laboratory examinations, which include mechanical analyses to determine grain size; plasticity to determine the liquid limit, plastic limit and plasticity index; volume changes to determine shrinkage factors; the moisture capacity; and resistance to flow of water.

Sieves are used to determine grain sizes of material coarser than 200-mesh and the hydrometer for smaller particles. The liquid limit is that moisture content, expressed as a percentage of the weight of oven-dry soil, at which the soil will just begin to flow when jarred slightly. The plastic limit is the lowest moisture content, similarly expressed, at which the soil can be rolled into threads ⅛ in. in diameter without the threads breaking into pieces. The plasticity index is the range of moisture content through which the soil is plastic. The shrinkage limit is the moisture content at which a reduction in moisture will not cause a decrease in volume, but an increase in moisture will cause an increase in volume. The shrinkage ratio is used in computing expected volume changes.

Instruction Aids. Discuss the various soil types and show samples; show equipment for making soil tests and demonstrate some tests. *References:* Bruce, Chap. 6.

DATA SHEET

SIEVE ANALYSIS

Wt of original sample 431 GM — Sample No SF-P3-2
Wt after prewashing 411 GM — Initials SDW
Washing loss 20 GM — Date 19 June 1945

SIEVE OR SCREEN	SIEVE OPENING (MM)	WT RETAINED ON SIEVE (GM)	WEIGHT PASSING SIEVE (GM)	WEIGHT PASSING SIEVE (%)
2"	50.8			
1½"	38.1			
1"	25.4	0	431	100.0
¾"	19.1	20	411	95.4
⅜"	9.35			
No 4	4.75	122+4=126	285	66.1
No 10	2.00	121	164	38.1
No 40	0.42	86	78	18.1
No 60	0.25			
No 100	0.149	37	41	9.5
No 200	0.074	15	26	6.0
Retained in pan		6		
Washing loss		20		
Pan total		26		
TOTAL		427		

Remarks: Error: 431−427 = 4 gm (added to wt of material retained in No 4 sieve). Largest size particle = 1"

Courtesy ARBA

Report on sieve analysis.

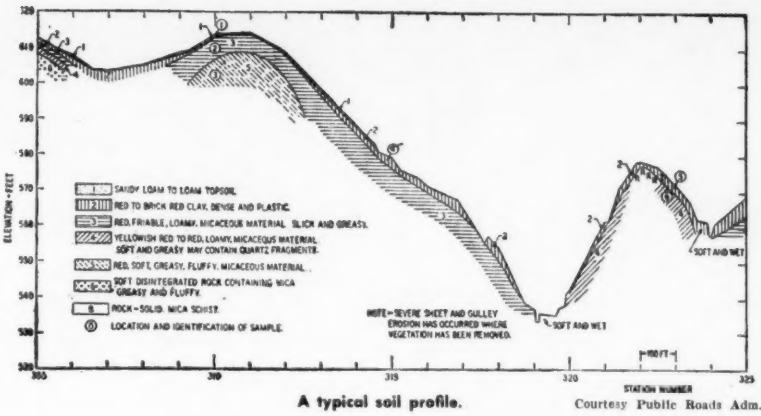
VIII—Soil Surveys

The purpose of a soil survey is (1) to determine the nature of the soil along the route of the road, the location of the various strata, and the existing moisture and density conditions; and (2) to enable the engineer to select the best route, specify the proper treatment of the base, select the road surface, plan adequate drainage, and provide suitable material for fills. The soil survey should be made as soon as the course of the road has been tentatively selected.

Determination of Soil Profile.—The soil profile is determined by means of test borings or pits, sunk along the center line at intervals of about 100 ft.; but where borings disclose uniform conditions the spacing may be increased. Where variable soil conditions exist, sufficient additional borings should be made to insure an accurate picture of conditions. In general, holes should be sunk to a depth of at least 6 ft. below both the natural ground level and below the finished grade in cuts. When free water or seepage is found, borings should extend through the water-bearing layer, if possible; and generally, the ground water level should be located. When borrow is necessary, borings should be made to locate suitable material. The thickness of each soil layer and its characteristics should be recorded, and each test hole should be located accurately by station and distance from the center line.

Sampling.—The number of samples for laboratory examination depends on the uniformity of the soil. Generally one sample should be obtained from each soil layer for each 1,000 ft. Samples should be shipped in tight containers to prevent loss of fines.

Preparing the Profile.—The profile of the ground surface is used as a base for preparing the soil profile. Thickness of soil strata as determined by borings are plotted to scale on the sheet and the profile constructed by connecting the points marking the limits of the different layers. Transverse profiles may also be drawn when soil variations justify. The vertical scale on soil profiles is about 10 times the horizontal.


ELEVATION - FEET
SANDY LOAM TO LOAM TOPSOIL
RED TO BRICK RED CLAY, DENSE AND PLASTIC
RED, FRIABLE, LOAMY, MICACEOUS MATERIAL, SLICK AND GREASY.
YELLOWISH RED TO RED, LOAMY, MICACEOUS MATERIAL, SOFT AND GREASY MAY CONTAIN QUARTZ FRAGMENTS.
RED, SOFT, GREASY, FLUFFY, MICACEOUS MATERIAL.
SOFT DISINTEGRATED ROCK CONTAINING MICA GREASY AND FLUFFY.
ROCK - SOLID MICA SCHIST.
LOCATION AND IDENTIFICATION OF SAMPLE.
NOTE - SEVERE SHEET AND GULLEY EROSION HAS OCCURRED WHERE VEGETATION HAS BEEN REMOVED.
SOFT AND WET
SOFT AND WET
STATION NUMBER

A typical soil profile. Courtesy Public Roads Adm.

Instruction Aids. — Demonstrate method of making soil survey; discuss field identification of soils, as texture, color, structure, consistency, etc. *References:* Bruce, Chap. 6; ARBA, Tech. Bull. 107, 1946; PRA, Principles of Highway Construction Applied to Airports.

IX—Moisture—Density

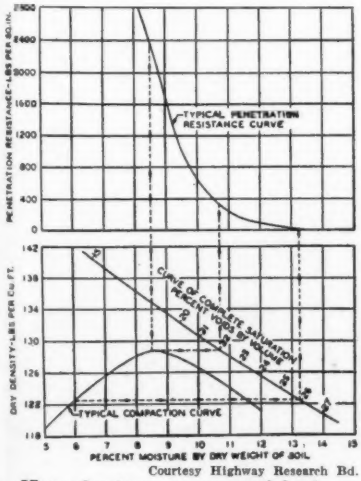
The density to which a particular soil can be compacted depends upon (1) its moisture content and (2) the compactive effort. A change in either moisture content or compactive effort results in a change in density. This relationship is utilized in practice to produce the densest soils at the least cost, which usually means with the last compactive effort. If a soil in an air-dried condition is placed in a container and submitted to a specific compactive effort, a certain density in pounds per cubic foot will be otbained. If a small amount of water is added and the soil similarly compacted, a greater density in pounds per cubic foot will be obtained. By repeating this process, increasing the moisture content each time, but using the same compactive effort, a moisture content will be found for which the density of the soil is a maximum.

Courtesy ARBA

Job compaction should equal laboratory compaction.

Tests.—The method of making moisture-density tests standardized by the AASHO (T99-38) is most commonly used. It consists essentially in determining the weight per cubic foot and percentage of moisture of samples having moisture contents, varying by 1%, compacted in three equal layers in a cylindrical measure, 4.0 ins. in diameter and 4.59 ins. high, by 25 blows of a 2-inch diameter cylindrical rammer weighing 5.5 pounds dropped from a height of 1 ft. The optimum moisture content is that which gives the greatest weight per cubic foot. The test may be supplemented by measuring the resistance of the soil to penetration by a standard blunt needle. The moisture-density relationship, and the resistance data, may be plotted on a chart and used as a guide for field control.

Instruction Aid. — Demonstrate the moisture-density and penetration tests. *References.* — HRB, Wartime Road Problems No. 11; ARBA, Tech. Bull. 107, 1946.


PENETRATION RESISTANCE - LBS PER SQ. IN.
TYPICAL PENETRATION RESISTANCE CURVE
DRY DENSITY - LBS PER CU. FT.
CURVE OF COMPLETE SATURATION
PERCENT VOIDS BY VOLUME
TYPICAL COMPACTION CURVE
PERCENT MOISTURE BY DRY WEIGHT OF SOIL

Courtesy Highway Research Bd.

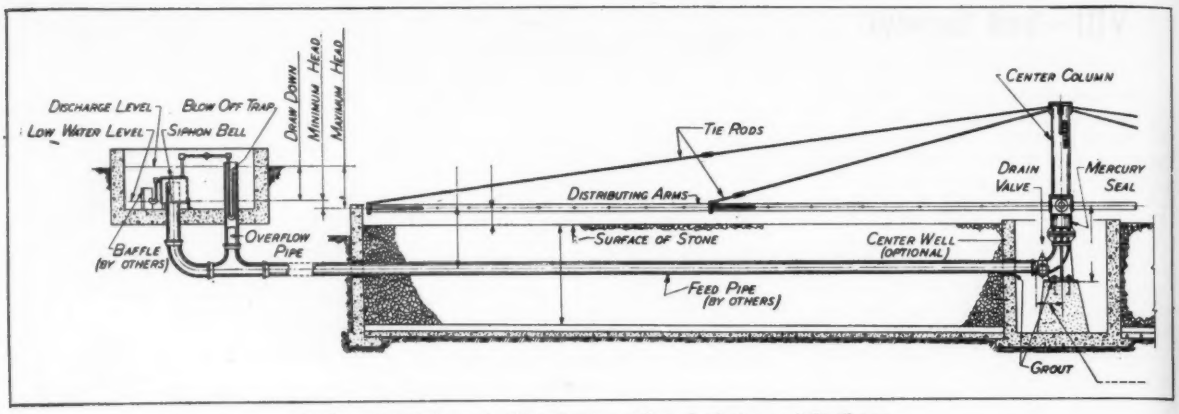
Effects of moisture on compacted density.

X-Compaction

Rolling equipment is used for all large-scale compaction work. Rollers may be smooth, pneumatic tired, or sheepsfoot. Smooth rollers for soil compaction should weigh not less than 10 tons and exert a loading of not less than 325 pounds per inch width of treads. Pneumatic rollers should exert a pressure of not less than 225 pounds per inch width of tread. For sheepsfoot rollers in sandy soils, tamping foot area should be 10 to 12 sq. ins., and pressure 50 to 100 pounds per sq. in.; in silty soils, an area of 7 to 9 sq. ins. and a pressure of 100 to 200 pounds; and in clays, an area of 5 to 6 sq. ins. and a weight of 200 to 400 pounds.

Embankment Construction.—Certain essentials are required for embankments in addition to proper compaction. The foundation must be firm to prevent subsidence; the embankment should rest on well drained soil. The use of sandy or other porous material in the lower layers of the fill aids in drainage. Muck should be removed by excavation or blasting. Proper side slopes are important. Preparation of the foundation for the fill includes clearing, grubbing, removal of root mat and

(Continued on page 38)



Section through low rate filter showing siphon, feed pipe and distributor.

TRICKLING FILTERS

By the Editors of Public Works Magazine and Consultant Staff

R. S. Rankin, B. A. Poole, F. H. Waring, H. M. Bosch, C. W. Klassen, Ray E. Lawrence, S. L. Tolman and J. J. Gilbert

This is the first of a series of articles intended to provide the most reliable possible information on the design, construction and operation of trickling filters.

SEVEN years ago this magazine began publication of a series of arcles on the design, construction and operation of trickling filters. The articles were published as a handbook of trickling filter design which found wide usage in solving the sewage treatment problems incident to mobilization for World War II. Since 1940, a great amount of data on trickling filters has been accumulated. However, much of it is based on military conditions and must be interpreted and adapted to the needs of municipal sewage and industrial waste treatment. This series of articles aims to present such interpretation, combined with other developments in construction and operation which have proved themselves desirable since the publication of the former series.

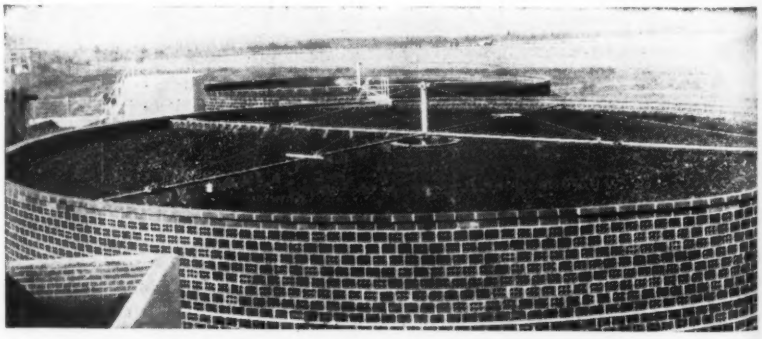
Trickling filters are the most generally used means of secondary or biologic treatment of sewage and also have a wide application in the field of industrial waste disposal. More than one-half of the sewage treatment plants at military posts in World War II included trickling filters.[1] In all, more than 300 army and navy installations utilized this method of treatment. The heavy loadings on some of these plants, and the unusually complete operating records available, provide valuable information. In addition, an increasing amount of data is available from the many municipal plants built within the past decade, including numerous high rate filters, a type of filter on which information was meager seven years ago, but is now quite fully accepted, and for which tested bases for design are available.

Terms Used in Sewage Treatment

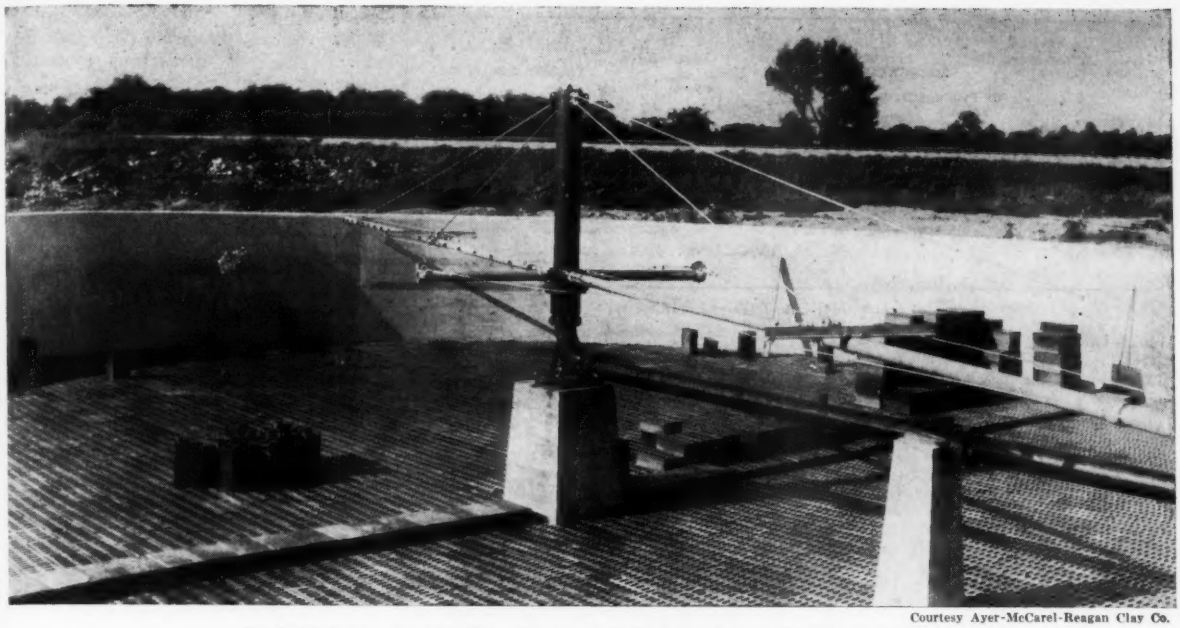
In sewage treatment, many terms and abbreviations are used to indicate precise meanings and for convenience. Among them are: *g.* or *gal.*, U. S. gallon; (the Imperial gallon used in Great Britain and Canada equals 1.2 U. S. gallons); *cf.* cubic foot, equal to 7.48 U. S. gals.; *cfs.* cubic feet per second; *cfm.* cubic feet per minute; *mg.* million gals.; *mgd.* million gals. per day; *mgad.* million gals. per acre per day, an acre being equal to 43,560 sq. ft.; *af.* acre-foot, an area of one acre to a depth of one foot, or 43,560 cu. ft., or 1613 cu. yds.; *gpm.* gals. per minute; *gph.* gals per hour; *gpd.* gals per day; *gpcd.* gals per capita per day.

BOD is an abbreviation for Biochemical Oxygen Demand, which is a measure of the decomposable organic matter in the sewage. As generally used, this turn refers to the 5-day BOD since laboratory examinations are usually made at the end of 5-days incubation, when the BOD is normally about 68% of the ultimate. The BOD is usually stated as ppm; but it may be translated into pounds by multiplying by 8.33. Thus, when the BOD is 300 ppm., there will be $300 \times 8.33 = 2499$ or 2500 pounds of BOD per million gallons of sewage. Research has indicated that each person connected to the sewers contributes about 0.17 pound of 5-day BOD per day.

Relative stability is also a measure



Trickling filter at Crowley La., in which hollow blocks were used for walls.



Courtesy Ayer-McCarel-Reagan Clay Co.

South Charleston, O., 68-ft. filter, showing underdrainage. Burgess & Niple, engineers.

of the decomposable organic matter in the sewage, but it is determined by simpler methods than BOD and with results not closely comparable.

Suspended solids in the sewage are those that can be removed by passage through an asbestos filter, as specified in Standard Methods.[4]

Dissolved solids are those that, like sugar in coffee, are in solution.

Colloidal solids are those that are too small to settle and in fact are midway in character between suspended and dissolved solids.

The terms used in this text will include the following: *Primary clarifier, primary tank* or *primary settling basin,* the sedimentation device ahead of the filter which prepares the sewage for treatment on the filter. *Intermediate clarifier* or *tank,* any sedimentation device between two or more filters. *Secondary* or *final clarifier* or *tank,* the sedimentation device following the final filter and usually providing the final treatment for the sewage. *Recirculation* is the return of a portion of the sewage that has already been filtered once and sometimes has also been settled, for another passage through the filter.

Theory of Operation

A trickling filter is an artificial oxidizing bed, usually of stone or slag or occasionally of ceramic material, with particles in the size range of approximately 1½ to 4 inches. Sewage is applied to the surface of the bed, which may be from 3 to 9 ft. deep, in the form of a spray, as uniformly as possible, and trickles down to the underdrainage system by which it must be collected promptly and discharged for further treatment, usually sedimentation. The filter media and the underdrain system must be such as to avoid clogging and permit the free circulation of air through the bed.[2] After a new filter has been in operation for two or three weeks, the surfaces of the filter media become coated with a bacterial gelatinous film, which is capable of removing a large proportion of the organic matter, as measured by the BOD of the applied sewage.

In a true sense, this method is not a filtration process. The interspaces between the filter particles are many times the size of the suspended and colloidal solids in the sewage; moreover, the need for the filter to become coated with a bacterial film before it will oxidize organic matter is not consistent with the theory of filtration.[2] Actually, the organic matter, whether suspended, colloidal or dissolved, is adsorbed and oxidized by bacterial action as the sewage passes through the filter. Air in the interstices of the bed provides the necessary oxygen. The liquid films are exceedingly thin. Folwell has computed that with a filter media of 2-inch spheres and a bed 6 ft. deep, to which sewage is applied at the rate of 1 million gallons per acre per day, the thickness of the film passing over the spheres would be 0.008 in. if it required 1 hour for the sewage to pass through the bed. Actually a much less time may be required for passage, but the illustration serves to show the extreme thinness of the film of sewage.

In general, most effective operation is attained when (1) the filter medium is uniform in size throughout the filter; (2) the distribution of sewage over the surface of the bed is uniform; and (3) adequate ventilation is provided to assure that each unit of volume of the filter contains ample air for furnishing necessary oxygen. In high-rate filters, additional ventilation facilities should be provided.

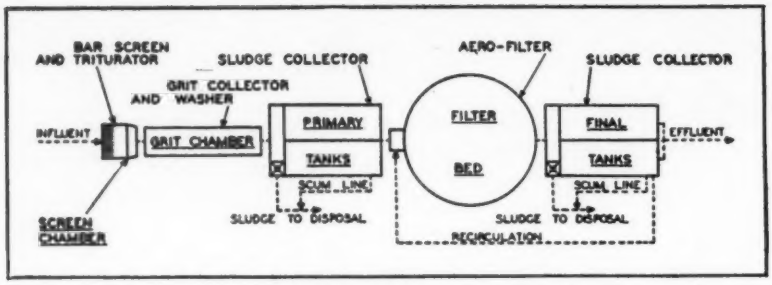
Advantages and Applicability

Trickling filters have the ability to operate when subjected to overloading, even for considerable periods of time. When grossly overloaded, the quality of the effluent may deteriorate, even though the filter is removing more pounds of BOD than design contemplated. The Great Lakes NTC filter was designed for 21,000 people but treated the sewage from an average of 57,800, with an effluent of 89 ppm. BOD, removing 1510 lbs. of BOD per acre foot. The high-rate shallow filter at Ft. Sill had a loading of 6,450 pounds per acre-foot, equal to 4 lbs. per cu. yd., and removed 4,060 pounds per acre foot, with a final effluent of 85 ppm. BOD. The plant at Ft. Dix, with a loading of 2320 lbs. per acre-foot, removed 2,080 pounds and produced a final effluent of 28 ppm. BOD.[1]

Trickling filters are but little affected by "shock" loadings, that is the application of heavy loads over a short period of time. In some army camps, pounds of BOD increased from less than 10% of the average to 175% of the average in about 2 hours[1]. Filters are also widely applicable to the treatment of many types of industrial wastes, which subject will be discussed in later installments.

Types of Filters

In considering trickling filters, the filter and the clarifier following it should be considered as a unit in both



Layout of typical high-rate filter of aerofilter type.

design and operation. Results of treatment should be based on the performance of the *filter and clarifier* team. There is no place in sewage treatment for a trickling filter without an accompanying clarifier in which to settle the filter effluent.

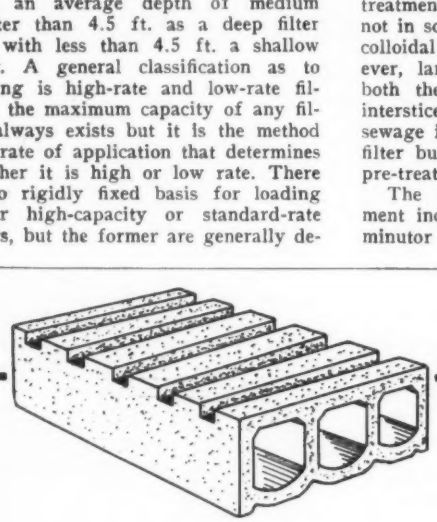
Filters are classified generally in regard to depth and to rate of loading. One depth classification[1] rates a filter with an average depth of medium greater than 4.5 ft. as a deep filter and with less than 4.5 ft. a shallow filter. A general classification as to loading is high-rate and low-rate filters; the maximum capacity of any filter always exists but it is the method and rate of application that determines whether it is high or low rate. There is no rigidly fixed basis for loading either high-capacity or standard-rate filters, but the former are generally designed to handle about 4 or 5 times the BOD loading of the latter, and also are dosed at very much higher rates. Specific information on loadings, depths, recirculation and other factors that affect treatment will appear in succeeding articles.

Pre-Treatment

To yield readily to trickling filter treatment, the applied organic matter not in solution in the sewage should be colloidal or finely comminuted. Moreover, larger particles are apt to clog both the distributing device and the interstices of the filter. Therefore raw sewage is never applied directly to the filter but is prepared for filtration by pre-treatment.

The general method of pre-treatment includes passage through a comminutor or through screens, followed by sedimentation. This process not only removes the larger particles which may clog the distributing system or the filter but, by removing much of the settleable solids, it also reduces materially the load on the filter.

A sedimentation period of about 2 hours should be provided; and since most sewage treatment plants are designed for some period in the future, as ten or fifteen years, the settling capacity provided must be ample for the expected future increase in flow. Consequently in the early period of use of the plant, the sedimentation period may be longer than 2 hours. For instance, with a present flow of 1 mgd., a design period of 15 years, and an expected flow at the end of that time of 1.44 mgd., sedimentation facilities would normally provide about 2.88 hrs. detention. This capacity can be provided by one or two tanks, either rectangular or circular. Septic tanks are used only for small installation, usually 15,000 gallons per day or less, for they do not furnish as efficient treatment in the larger sizes and have no other compensating advantages. Imhoff tanks may be used in sizes above the septic tank limit, but the standard settling tank with sludge collection and removal equipment and separate sludge digestion has many advantages in operation. In trickling filter plants involving recirculation, standard settling tanks are considered superior to Imhoff tanks.



TRANSLOT

The Efficient Filter Block with the Transverse Slot

TRANSLOT blocks are made from Vitrified Clay, the EVERLASTING and ACID PROOF material. Its Salt Glazed, smooth walls permit the rapid flow of sewage.

Transverse Slots across the top of the block provide properly proportioned openings into the ducts for collecting downward flow of liquids and the upward passage of AIR.

Lengthwise grooves on under side of each block hold alignment when laying. Uniform in size, 6 blocks cover a square yard of filter floor. Self aligning and self spacing, they are easily and rapidly laid on 1 foot centers. Translot, made with standard fittings, can be used on all types and designs of Trickling Filter Beds.

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2. Made from vitrified clay and salt glazed.
3. 12" wide and 18" long—easy to figure.
4. Cross Ventilation betwen ducts made possible by transverse slots.
5. Furnished with all shapes—Manufactured to your plans.
6. Properly proportioned apertures provide thorough ventilation and rapid run off.
7. Close dimensional tolerances and carefully inspected.
8. High in compressive strength—Low in absorption.

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Cannelton Sewer Pipe Co. CANNELTON, INDIANA

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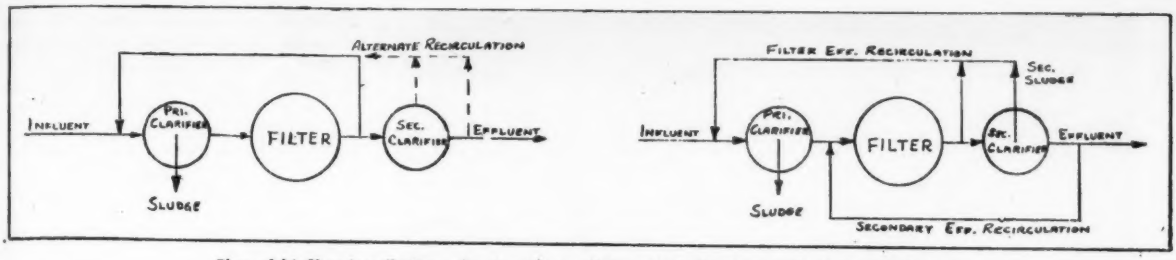

Plan of biofilter installations, showing intermediate and single stage with dual recirculation.

Removal of BOD and suspended solids by settling tanks depends on the strength of the sewage and the uniformity of flow. Keefer reported the average removal of BOD by primary settling tanks in 26 municipalities as 35.1%, the average BOD of the raw sewage being 234 ppm. In municipal plants having stronger sewage, the percentage removal may be as high as 40%. The NRC report showed a larger removal for military installations—28.5% where the sewage strength was under 350 ppm. BOD, and 35.0% where the BOD was over 350 ppm. This lower efficiency was ascribed principally to the irregularity of flow, with unusually high peaks, in the military plants.

The Upper Mississippi Valley report used a 30% BOD removal in the primary clarifier for computing filter loadings. A 35% removal is often used in design. The selection between these two may depend upon State Board of Health regulations or upon the degree of conservatism that it is desired to use in design. The removal of suspended solids by primary tanks is somewhat greater than BOD removal and may amount to 45% to 60%.

BOD removal by primary settling is important because it lessens the load on the filter; and the lower the BOD in the sewage applied to the filter, the lower is the BOD of the filter effluent. Reduction in suspended matter also reduces the probability of the filter clogging.

A stronger sewage applied to the filters may result in a *higher percentage of reduction* of BOD, but the BOD of the filter effluent may also be higher. Therefore the higher the degree of pretreatment, the better will be the final effluent. Forman and Shaw[3] compared day and night flows of a number of New Jersey low rate trickling filter installations. For seven plants with daytime sewage averaging 495 ppm. BOD, the reduction was 82.8% and the plant effluents averaged 85.5 ppm. The night flow of sewage averaged 281 ppm. BOD, the reduction was 80%, and the effluents averaged 58.1 ppm. BOD.

Post Treatment

It is not the function of the trickling filter to remove the suspended matter in the sewage applied to it, but rather to change its character from unstable and decomposable to relatively stable. The trickling filter removes only a small part of the total solids, which, when applied to it are mainly in a finely divided state, or in solution. In addition to oxidizing them, the trickling filter changes the suspended and colloidal solids to a form that will settle if passed through a sedimentation tank. Also, the spent gelatinous film on the filter stone, which sloughs off continuously in the high-rate filter and intermittently in the

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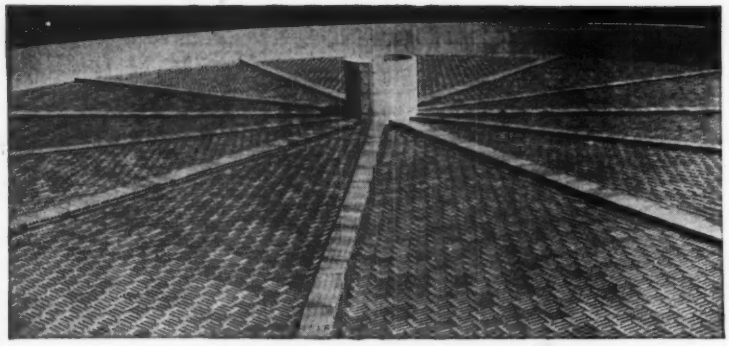

The underdrains in this trickling filter slope to the center.

low rate filter should be settled out.

In general, the same detention period should be used in settling tanks following filters, ordinarily called secondary settling tanks, as in primary tanks. Usually this is 2 to 2¼ hours, but may depend upon the type of filters used; recirculation, if any; and State Board of Health regulations. Secondary settling tanks should be designed for the specific filtration process utilized in treatment, and more detailed information regarding them will be given in the sections treating the various methods of filtration.

The NRC report stated that secondary settling tanks at military installations reduced BOD, as follows: Tanks without recirculation, from 81 ppm. to 47 ppm., or 42.7%; and tanks with recirculation, from 79 ppm. to 61 ppm, or 25.6%. Suspended solids reductions, on the same basis were 61.8% and 47.4%.

General Essentials In Filters

A primary essential in trickling filter design is a competent analysis of the expected load and the provision of adequate media volume to treat it. The mechanics of design will vary with the type of filter used. (Examples of computations will be included in later installments for each type of filter.) A second essential is good media. This must be of the proper particle size, and clean; and it must be prepared and placed so as to avoid pockets of dust or smaller sized stone. A third essential is good underdrainage, which will carry off promptly the liquid passing through the filter and will also provide adequate ventilation. Finally, the distributing device must be of adequate size to handle both maximum and minimum flows, and designed to meet the particular operating needs of that filter.

Bases of Loading

For many years the volume of sewage flow was the principal or only factor influencing filter volume. The generally accepted rate of application was 300,000 gals. per acre-foot per day, or about 7 gallons per cubic foot of filter per day. Experience demonstrated the need for a better method of determining the volume of filter media needed. The organic load, in terms of pounds of BOD, is now generally used as the prime basis for design, but volume of flow often must be considered; and in addition the concentration or strength of the sewage and its treatability or resistance to oxidation may influence design.

In computing volume by BOD, the following procedure is used. Assume a sewage flow of 1.0 mgd., and a BOD of 300 ppm., which is reduced to 195 ppm. by primary treatment. The pounds of BOD is 8.33 x 195, or 1625 pounds. At the loading rate of 400 pounds of BOD per acre ft. for standard rate

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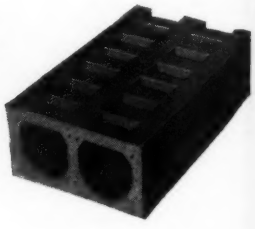
For Better Trickling Filter Operation



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High compressive strength.

High resistance to acid or chemical action and deterioration from any cause.

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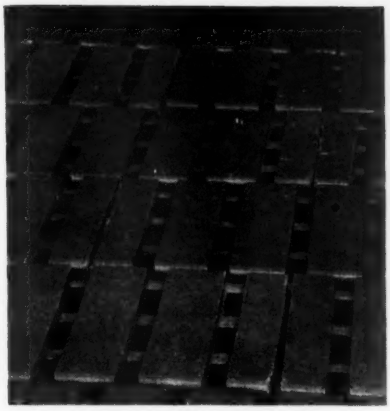
filters, there would be required 4.06 acre-feet, or about 6,500 cubic yards of stone. If the filter depth is taken at 6 ft., the area of the filter will be .68 acre.

The median value of BOD loading on standard rate filters in military installations (NRC report) was 377 lbs./af. The median value of mgad. was 1.13, and since the filters averaged over 6 ft. deep, the rate per acre-ft. was low. However, these data are influenced by the low rate of water consumption and the correspondingly small sewage flow per capita, the average value of which for the plants included in this list was 74 gals.

Design must, of course, comply with State Board of Health requirements in regard to loadings. These requirements are now in a state of flux. Though many states still retain their pre-war requirements for filter loading, based on low rate filters, most of them will approve higher loadings when based on sound design factors.

Economics Of Design

If a filter does not provide the degree of treatment locally necessary, the money spent for it is largely wasted. Therefore, the primary economic factor in design is to insure that the filter is so designed and constructed that it will produce an effluent suitable for that locality. Secondary important elements are first cost and operating costs, but even these should be subordinated to flexibility in operation and a margin of safety in capacity.



Close-up of filter underdrain.

The size of the filter being satisfactory, consideration should be given to those items that may or will influence the results of operation, such as a suitable distributor, good underdrains, and adequate ventilation. Costs should be computed including the cost of construction, and interest and amortization on this cost; the cost of pumping, if this is required either by the topography or by the method of treatment; and the cost of operation, including **superintendence,** labor and supplies. In general, a design that will permit operation with one shift of personnel, instead of three shifts, will accomplish a greater long-time saving than any other single item.

With low-rate filters, the volume of stone is fixed, but depth variations may be possible in the range between 6.0′ and 9.0′. The deeper the filter, the smaller the filter surface, and the less the cost of the containing wall, the distributor, the underdrainage and the floor system; and perhaps the fewer the number of filters, which it is sometimes possible to reduce by utilizing larger units. All these factors may reduce the cost.

High-rate filters, especially of the shallow type, are not generally subject to such minor design economies, though the overall cost may be reduced by using larger units and planning recirculation carefully. In areas where there are marked seasonal load variations, such filters may sometimes be used as standard trickling filters during periods of relatively light load.

With all filters, irrespective of the type or the initial cost, no economy should be adopted that may interfere with the prime purpose and function for which the plant is intended, which is to provide adequate sewage treatment. The plant also should be so designed as to make proper operation easy and natural.

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5—PERMANENT CONSTRUCTION Blocks laid with reasonable care are as permanent as the filter itself.

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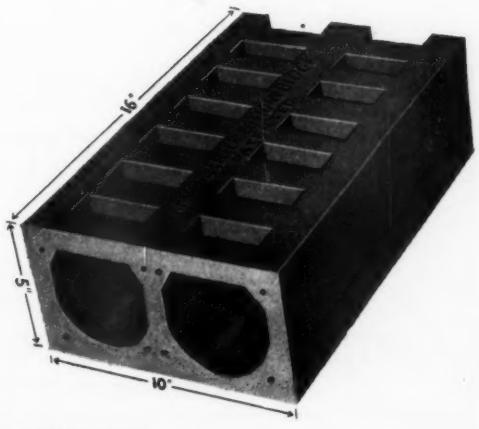

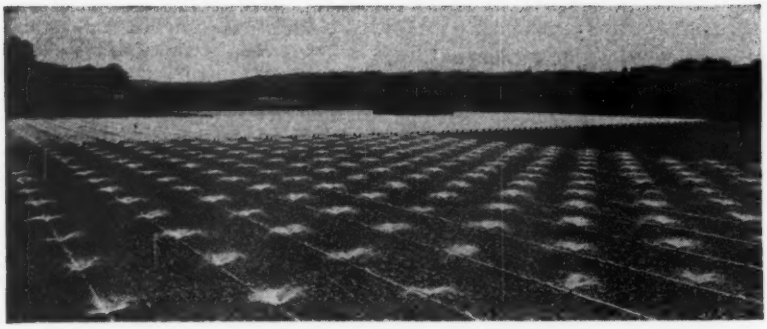

A large filter installation using spray nozzles.

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[1]Report of Subcommittee on Sewage Treatment at Military Installations, National Research Council Sewage Works Journal, Sept. 1946, Vol. 18, No. 5. Hereafter referred to as NRC report.

[2]High Daily Rate Trickling Filter Performance. Report of Board of Public Health Engrs. Upper Mississippi Basin. Hereafter referred to as Upper Mississippi Report.

[3]Proceedings, 20th Annual Meeting, New Jersey Sewage Works Ass'n., 1935. p. 68-97.

[4]Standard Methods for the Examination of Water and Sewage, 4th Edition, 1946, American Public Health Ass'n, 1790 Broadway, N. Y.

The next installment, covering underdrainage, walls, floor, channels and other structural details will appear in the March issue. Low-rate filters will be treated in the April issue.

On-the-Job Training for Highway Department Personnel

(Continued from page 31)

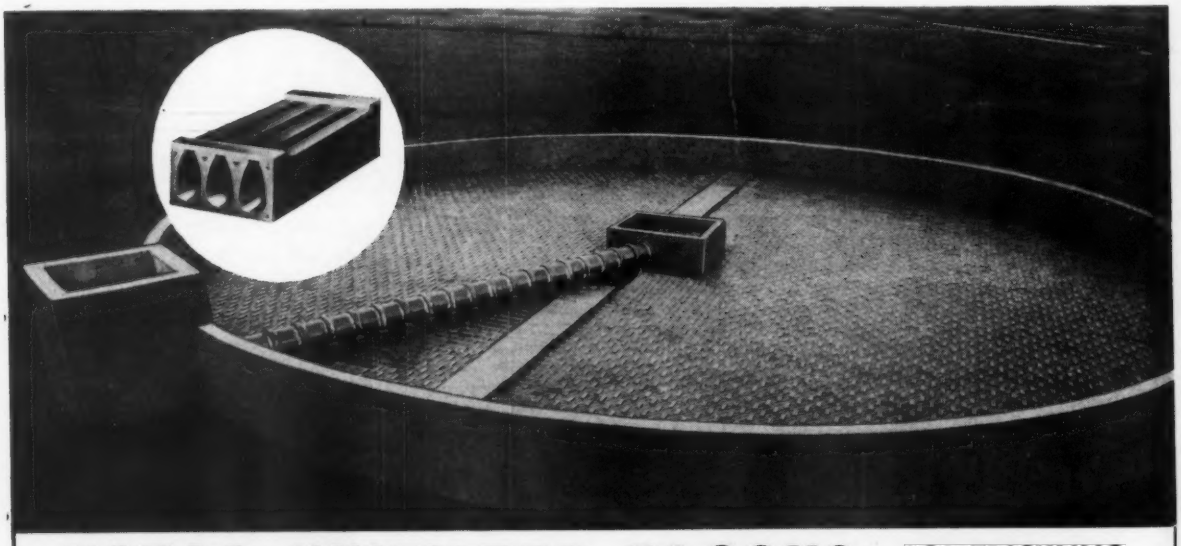
other objectionable material. The first layer of fill should be a leveling course and should be properly compacted.

Embankments should be constructed in layers not to exceed a depth based on the soil and the method of compacting, and it should contain the moisture necessary for maximum density. For smooth or penumatic rollers, layers should not exceed 4 to 6 ins. depth of loose soil, but thickness for each of the various soil types should be determined by tests and trial. Sheepsfoot rollers will satisfactorily compact deeper layers than the flat or pneumatic rollers, but more passes are required. For instance, sheepsfoot rollers require about 2 passes per inch thickness of layer as compared to a total of 3 or 4 passes with the other rollers. Soil handling equipment capable of spreading the fill in layers of the required thickness must be used or other provision made for placing in layers.

Control of the compaction process involves the following procedures: (1) compaction tests to determine moisture-density relationships of the soils to be used, procedures for which have already been discussed; (2) moisture determinations of the soil to be compacted; (3) density tests of the soil in place in the embankment.

Instruction Aids.—Typical specifications for consolidating an embankment; reports from an actual job of results vs tests. *References.*—HRB, Wartime Road Problems No. 11; ARBA, Bull. No. 109, 1946.

(EDITOR'S NOTE: *The next installment will consider sub-bases, bases, and certain types of surfacings.)*



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Public Works Engineering Methods and Data

New Jersey Rainfall Intensity-Frequency Data

The New Jersey State Highway Department has prepared the accompanying chart of expected rainfall intensity-frequency, which is based on the work of David L. Yarnell, reported in Pub. 204, U.S. Department of Agriculture. These data represent recorded rainfalls over a period of about 33 years, for various lengths of time and frequencies. The figures used in making up the accompanying graph are those shown for the central part of New Jersey. The data for the northern part of the state indicate intensity-frequency about 10% less, and for the southern part of the state about 10% greater than those shown.

When the time of concentration for an area under consideration is determined, enter the graph from the top or bottom on the line corresponding to that period of time. Follow the line to the point where it is intersected by the curve of the frequency to be designed for. From this intersection, follow a horizontal line to the left border to determine the rate. For instance, the rate of rainfall in inches per hour for an area having a time of concentration of 20 minutes, with a design period of frequency of 25 years, is found to be 5 inches. For a 30-minute time of concentration and a frequency of 10 years, the rate is 3.45 inches per hour. These rates should be adjusted for northern or southern New Jersey areas as previously noted. The vertical scale on the chart is logarithmic; the horizontal scale is arithmetic.

Two Cities Agree on Joint Operation of Water Supply System

Saginaw and Midland, Michigan, have entered into an agreement to build and operate jointly a water supply system to be constructed at an estimated cost of $11,500,000. The system will include a submerged crib in Lake Huron at Whitestone Point, a 66-inch intake pipe, 48 miles of 48-inch and 30 miles of 36-inch pipe, two pumping stations, reservoir, meters, and chlorinators. The project is to be financed through 30-year serial water revenue bonds callable after September 1, 1949. The Saginaw bond issue was for $4,800,000, and that of Midland for $6,000,000. These bonds were sold on September 10, Saginaw receiving a net interest rate of 1.86 per cent and Midland 2.13 per cent. All planning and construction is being supervised by a special committee consisting of five members from Saginaw and four from Midland. The management of the joint system is vested in a six-member board that will administer the system after it is completed. The city manager of each city has been appointed to this board for a six-year term. The other two members from each city have received the four- and two-year beginning terms. The board may contract with either city for the maintenance of the system and may sell water along the joint line.

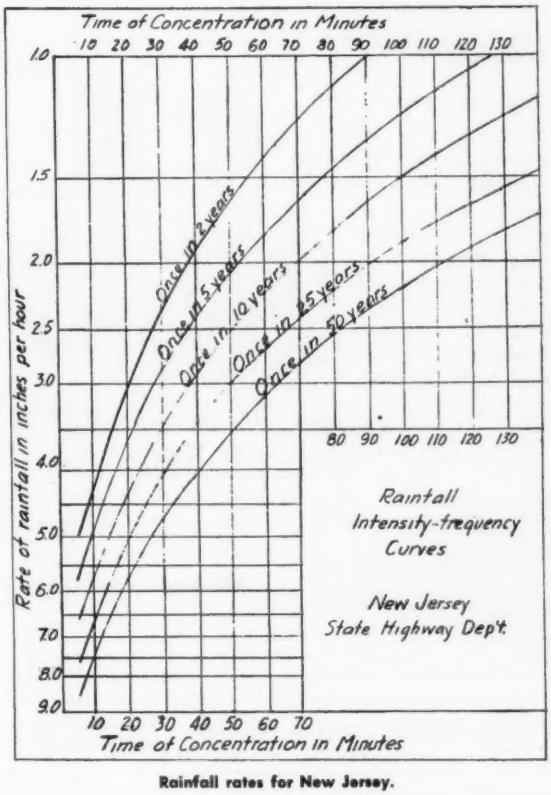
Annual operating costs are estimated at about $110,000—$59,000 allocated to Saginaw and $51,000 to Midland on the basis of the amount of water used. To meet operating costs and debt service charges Midland raised water rates about 30 per cent, and Saginaw increased water rates by about $4 per year per consumer. Charges for water to consumers outside the city will be determined by each city and the joint operating board and may be approximately double the rates inside the city.

Construction contracts in the amount of $10,233,683.65 have been awarded. All bids were firm except on 1½ per cent of the work where a 20 per cent escalator clause was accepted. Work will begin soon and it is expected that delivery of water from the new source will begin about September 1, 1948.—*Public Management.*

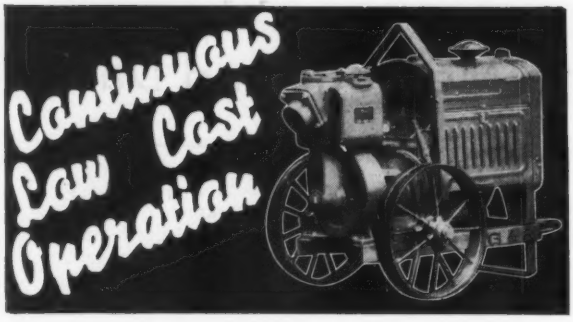
Cost of Laying Water Pipe in Hartford, 1945

Costs of laying water pipe in Hartford, Conn., during 1945, are analyzed in the reports of the Water Bureau for that year, which has just arrived. The amounts of 2-in., 4-in., and 6-in., that was laid was so small as not to provide reliable cost data.

8-inch—A total of 19,632 ft. was laid, at an average cost of $2.717 per ft. Of this, 62.4 ft. was laid with all hand labor at a cost of $7.488 per ft. of which $3.524 was for labor. Trenching was furnished on 4,480 ft., for which labor costs were $0.386 and material costs $1.525, a total of $1.911 per ft. The remaining 15,091 ft. cost $1.056 for labor, $1.712 for material and $0.161 for miscellaneous items, a total of $2.929. The trenching on this portion of the work was by machine.



Rainfall rates for New Jersey.



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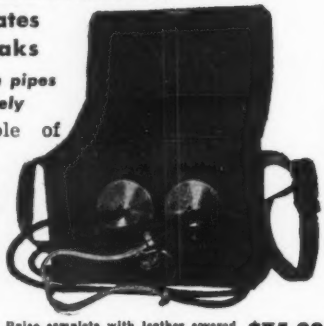

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10-inch—All of the 647.2 ft. was laid in machine-dug trench. Labor cost $2.702 per ft., and materials $1.336, making a total cost of $4.038 per ft.

12-inch—There were 6,263 ft. of 12-inch pipe laid, all with machine trenching. Labor costs amounted to $2.726, materials to $1.129 and miscellaneous items to $0.057, a total cost of $3.932 per foot.

Costs for Laying Water Pipe in St. Paul

Costs for laying 6-in. and 8-in. water pipe in St. Paul, Minn., during 1945, are given in the recently received report of the Water Commissioners for that year. On 9 jobs of 6-in., totaling 4,576 ft., in which were used 33 specials, 9 gates and 7 hydrants, costs were as follows: Labor, $1.03 per ft., average, varying from $0.81 to $1.52; materials, $1.14 per ft., average, varying from $0.94 to $1.50; total cost, $2.17 per ft., average, varying from $1.82 to $2.91. The work was done between May and November, and excavation was principally in clay and stone, or sand and clay.

Two sections of 8-in. were laid between August and November, totalling 1,345 ft., in clay and stone, on which labor costs averaged $0.97 and material costs $1.34, a total of $2.31 per foot. Costs on the two projects were almost identical throughout.

The cost of constructing two jobs, totalling 114 ft. of 3-in. service pipe in sand averaged $5.78 per ft.; and for 74 ft. of 4-in. service, 3 jobs, in sand, gravel and clay, $7.55 per ft.

A Mississippi Soil Cement Stabilization Job

A soil cement base project is now under construction by the Delta Paving Co., Jackson, Miss., for the Mississippi State Highway Department. This is a 15.4-mile section on Miss. Rte. 1, from Benoit north to Beulah. A preliminary soil survey showed that the underlying soil in the roadbed was a very plastic delta clay that changed volume considerably when wetted or dried. However, a source of fine sand-silt was located and used for the job. The quantity of cement necessary to stabilize this material was determined; the selected soil was then hauled in to the roadbed and bladed and shaped to rough section. Moisture-density determinations were then made. For cement-soil construction, the soil should contain moisture in excess of the optimum for compaction—generally up to 2% higher. A constant check was made to insure proper moisture control during construction.

After the water, if necessary, and the cement have been added, the soil and cement are mixed with a traveling mixer which combines pulverizing and pug-mill actions. This machine covers an 8-ft. strip at each pass, leaving the mixture in a uniform layer of the proper depth. Since the road is 22 ft. wide, three trips are necessary. As much as 2200 feet of 22-ft. wide surface has been mixed in a single day.

Campacting operations follow immediately behind the mixer. The first unit of the compacting team is a sheepsfoot roller, which is kept on the secton until it "walks out." The surface is then shaped to the required grade and section and rolling is continued, using a pneumatic-tired roller, until the entire section of the base is thoroughly compacted and presents a firm, smooth and closely knit surface. A protective covering of about 4 pounds of straw per sq. yd. is then placed and is kept moist for 7 days, after which the road is opened to traffic. A 1½-inch bituminous wearing course will be placed under an existing contract.

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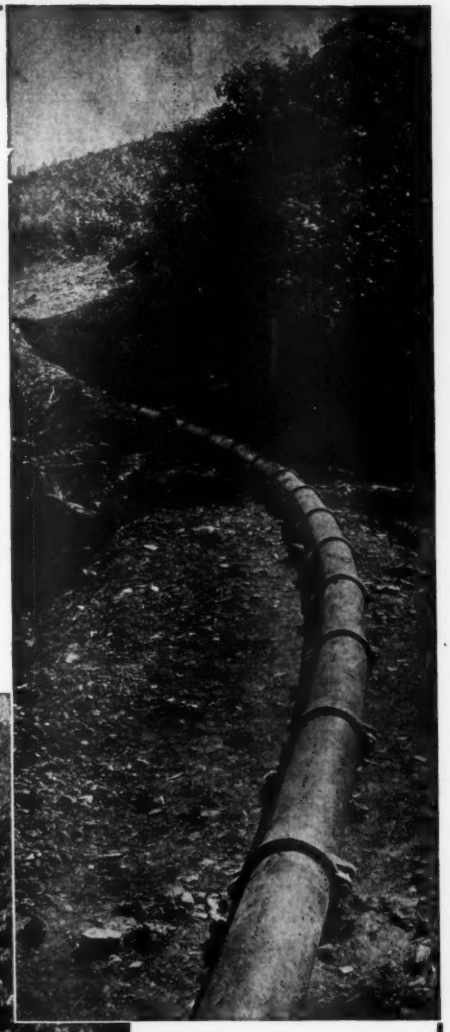

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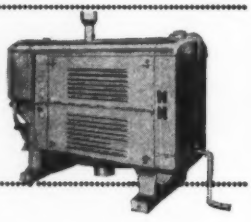

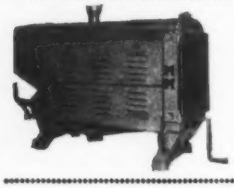

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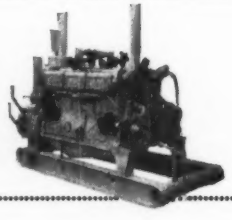

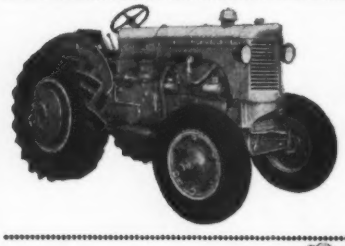

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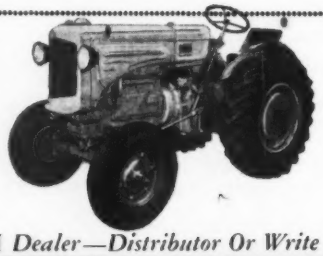

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Inventory and Stock Control

(Continued from page 28)

past years' experience and anticipated changes in the future.

By avoiding small and detailed estimates the sewage works manager is given a free hand within his spending authority, and is able to organize the work to the best advantage without having to consider the effect on detailed estimates. So long as he keeps within the total estimate, an overspending on one item and underspending on another is of little importance. Budgetary control to fine limits too often results in managerial strangulation.

Both the works manager and the Sewage Committee will need to know from time to time, as the year progresses, how expenditure compares with the estimate. The keynote in providing these statistics should be simplicity. It is assumed, of course, that job-costing is being carried out at the works; by means of these cost accounts the manager will be able to keep every item of expenditure (labor as well as materials) under careful observation.

Costs

The collection and publication of sewage purification cost data by the Ministry of Health was not only an impetus to authorities to institute adequate costing systems in their sewage works departments, but provided a valuable means of comparing the costs of this service in similar towns. This was one of the many useful services which had to be suspended during the war, and it is to be hoped that the Ministry will call for the necessary returns and resume the publication of those statistics in the very early future.

Costs of sewage purification have already been the subject of a number of papers presented to the Institute, and it is necessary here only to emphasize that no sewage works department can be considered fully efficient if its functions are not properly and adequately costed, and the costs reviewed in the light of similar data for comparable towns.

Renewal Funds

It is sound financial policy to make provision for adequate funds to be available when required for the replacement of working assets, such as plant, vehicles, diffusers, etc. If no such provision has been made, the purchase of relatively expensive equipment of this nature from revenue account may cause a sudden heavy drain on the finances of the department, and there is little to commend the use of loans for such purposes.

The operation of a renewal fund built up by an annual allocation to it of a part of the appropriation assists materially in stabilizing the annual rate.

Insurance

The Factory Act requires that all lifting tackle, pressure vessels, etc., shall be regularly inspected and tested, and in the main the simplest and most satisfactory method of meeting this statutory requirement is to arrange for it to be carried out by an insurance or other company specializing in this type of business.

Sooner or later the question invariably arises as to whether other plant and machinery shall be insured for inspection and against breakdown. This is a matter of policy. Some of the larger authorities include in their staff men qualified to carry out the prescribed tests; they also have sufficient finances to build up

their own insurance funds, and so to carry their own risks in respect of fire, workmen's compensation, explosion, lifting tackle, vehicles, etc.

The premiums quoted are usually so reasonable as to make this course not generally attractive, however, and so far as mechanical plant and that covered by the Factory Act is concerned outside insurance has the big advantage that the insuring company's technical representatives regularly make periodical inspections and tests of the plant, and the insurer receives a formal report on the condition, together with any recommendation for the improvement of safety measures which the inspector thinks advisable.

Cannery Waste Treatment and Disposal

(Continued from page 20)

one ton to two tons per acre before discharging the acid tomato wastes to it so as to avoid imparting undue acidity to the soil. The client was taught to recognize those signs which indicate soil acidity. (4).

2. The lagoons are located at the crest of a steep hill which permits easy distribution of the liquid wastes over the land surface by pumping and gravity flow. The crest and steep sides of the hill in question consist of a loamy soil which tends to suffer from lack of moisture during the dry season and will, therefore, be improved by the irrigation treatment. This type soil readily absorbs the moisture applied.
3. Since the lagoons are located at the crest of a hill, it is possible to discharge the lagoon wastes in the direction away from the cannery and from neighboring dwellings into open farming country, thus avoiding complaints which might otherwise arise.

Summary

The selected method for disposal of the cannery wastes is characterized by several desirable features:

1. Stream pollution, due to discharge of the cannery wastes to a local stream, is completely eliminated;
2. These improvements were made with a minimum of change in the canning operations, and at low cost for new equipment and installations;
3. The waste treatment system is simple and easy to operate;
4. Recoverable waste materials are recovered and sold in the form of stock food;
5. Non-recoverable wastes are utilized for fertilizer purposes and to provide moisture which may be needed in the dry season;
7. The method of disposal avoids nuisance conditions which sometimes ensue in disposing of cannery wastes.

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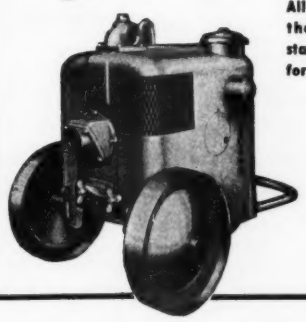

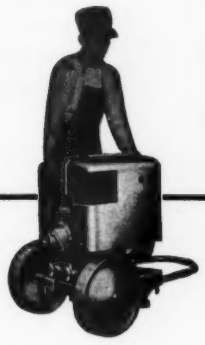

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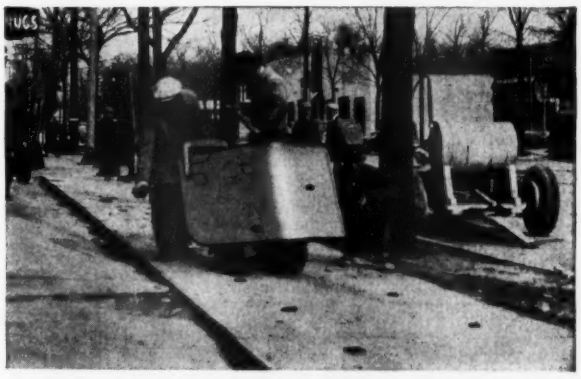

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Public Works Digests

Water Supply · Sewerage · Highways and Airports

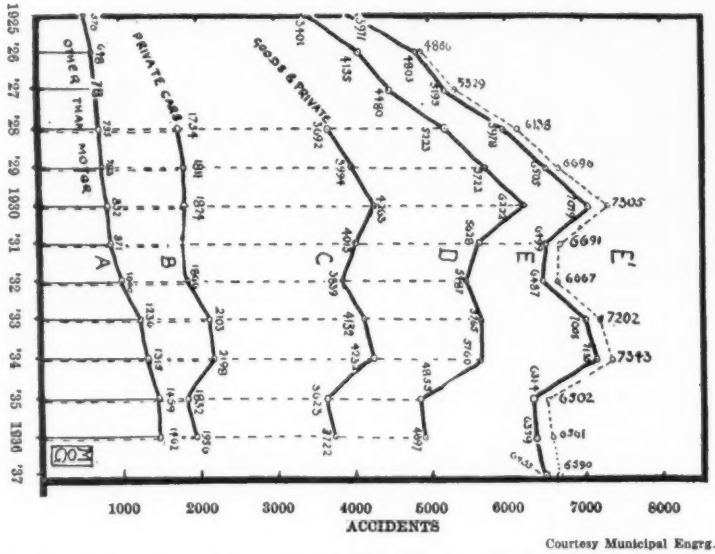
In this section are digested and briefed the important articles appearing in the periodicals that reached this office prior to the 15th of the previous month. Appended are Bibliographies of the principal articles, in which the articles in each periodical are numbered consecutively throughout the year, beginning with our January issue.

The letter and number at the end of each digest refer to those used in the Bibliography. Numbers not found in the current Bibliography will be found in the one published the previous month.

The Highway and Airport Digest

Mesh-Reinforced Asphalt Pavement

In 1943 the Texas highway department resurfaced some old concrete pavement with 1½" of cold-mix asphalt. The cracks in the concrete showed through at once, and the district engineer tried using some 6 x 9 in. wire mesh as reinforcement in connection with placing a second 1½" layer of asphalt, the wire mesh being laid on top of the first layer. This was used on 300 lin. ft. of pavement. A year later not a crack showed in this section, but cracks did show in the rest of the road immediately adjoining. On the strength of this, in resurfacing 8.13 mi. of U. S. 90 this year the old pavement was patched and tack coated, a 1" layer of hot sheet asphalt was placed and rolled; on this was placed mesh of No. 9 wire spaced 6 x 12 in., and this was covered with 3" of hot mix placed and rolled in two layers. The reinforcement cost about 15 cts. per sq. yd.[N15]



Courtesy Municipal Engrg.

Accidents to five groups of road users in Great Britain, D, all motor vehicles; E, all causes; E', all deaths.

Repairing A High Road

The road up Pikes Peak reaches an altitude of 14,109 ft. where water boils at 180°, and radiators of motor equipment steam copiously climbing the 14% grades. The 18 miles of road are of stone and gravel, and had washed badly while closed during the war, largely because the culverts were filled with ice. Repairs were begun by chopping out this ice by hand, and removing the snow by use of a shovel mounted on a 4-wheel drive, 5 ton truck, all equipment operated at low gear. Following the plow, motor graders cleaned up minor snow pockets and fresh falls, and continually reshaped and bladed the road, supplementing work done by a bulldozer. The road up Mt. Evans, reaching an even higher altitude, has needed little repair, thanks chiefly to its well built bituminous surface.[N19]

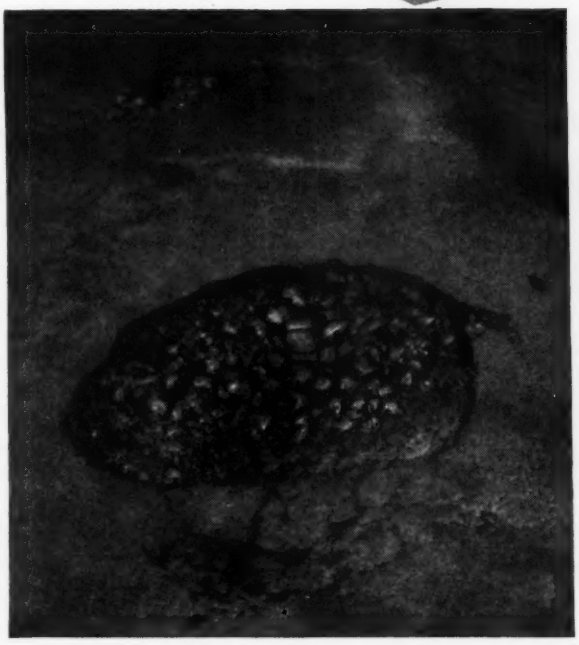
Research on Road Traffic

Many guesses of the causes of traffic accidents have been made, and attempted remedies based upon them; for instance that high speed was the cause, but speed limit laws failed to reduce the accidents materially. Scientific research to determine the causes of accidents must precede the formulation of regulations and construction details. The British government last May appointed a Scientific Research Board on road traffic. The data it collects should cover all features that might affect accidents. For example, did the number of accidents decrease following 1930 because of more careful driving, or decreased traffic, or less foggy weather, or because the 20 mph. speed limit was abolished?

The author suggests the following investigations:

Is not the problem of safety and circulation the same? Are or are not congestions a main source of accidents? How much would street output gain

HAVE YOUR ROADS GOT SPRING FEVER?



IN the spring, local eruptions caused by frost heavings often create pot holes and surface breaks that are not only a menace to the safety of motorists, but also a menace to the life of the road. If uncared for, they will wreck even a good pavement.

To the over-burdened road official, faced with important new roads which must be built or old roads which must be re-surfaced, this constitutes a tremendous problem.

But it need not be!

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"The Longest Mile," a 30 minute, full-color, 16-mm. sound film on the development and importance of roads will soon be available for showing to highway officials, engineers and civic groups. Ask the Tarvia field man for it, or write the nearest Barrett Tarvia office.

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from driving buses into embayments for their stops, or from expediting the discharge of vehicles from theatres, etc., by elongating the awnings manyfold along the footway? How much road output is lost by a slow horsed vehicle, by a standing vehicle, by a four-foot wide refuge, by acute pavement corners, by unfindable street name plates, and house numbers, by the absence of sign posts guiding drivers to urban exits?

When a roundabout's circulation is retarded by crowding what controlling rules will improve its output? What is the most efficient plan form of outlets? By what percentage will a rule of walking on the extreme left increase the output and reduce the casualties due to crowded footways? What is a money estimate of this gain? Would it not *pay* to clear crowded footways of all the usual nine obstructions by putting them elsewhere or in the walls nearby as is currently done abroad?

As traffic delays have a money value, estimate that value, as a guide to what expenditure on the remedy is justified. Organize a statistic of urban accidents and tabulate their relation to traffic speeds (in 5 mile steps). Experiment to find the probable gain of time (from point to point) for vehicles from a universal "keep to the extreme left of the available space" regulation. Would not the resultant emptier road crown assist crossing pedestrians? Should pedestrian crossings at control points have a "herring bone" plan to enable halted drivers to see them better when about to restart?

What is the safest location for pedestrian crossings near a Tee junction?

Devise a scheme for recording (as a sort of Gallup poll) the gain or loss of traffic fluidity (afoot or awheel) that results at any time from experimental changes made in the road plan, or in traffic controls, or incidental to road excavations, or in bus or taxi strikes, or by improved illumination or by diversions for processions, etc.[11]

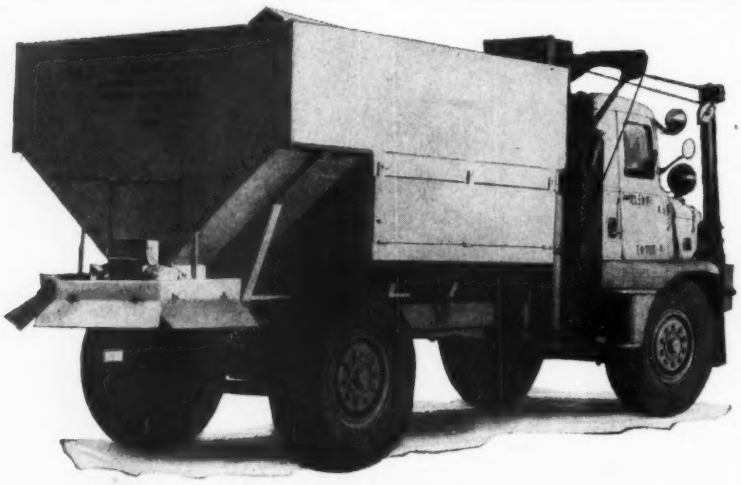
Stabilizing an Airport Surface

At an airport near Henderson, Texas, 93,000 sq. yd. of runways and taxi strips were surfaced last fall with soil-cement, 6" thick for runway and 7" for taxiways and turnaround areas. The soil was uniformly a fine sandy loam. After the surface had been graded, soil-cement processing was performed in 9 ft. lanes, 400 to 600 ft. being finished followed by a 40 to 50 ft. gap for turn-around areas; which gaps were afterward processed crosswise. The cement used throughout was 8% by volume, spread on the loose soil, using a tow-type spreader box, in two passes. (A better method of spreading cement is desirable, and at least one equipment manufacturer is working on it.) Mixing was performed with a post-war "single-pass" stabilizer, operated by one man, at speeds up to 31 ft. per minute. In this, a high-speed cutting rotor under a hood pulverizes the soil and mixes in the cement and water. The optimum moisture content was 11.3%. The stabilizer spread the material flat, and it was at once compacted with a dual-drum sheepsfoot roller. The surface was then shaped with a blade, nail-dragged to remove any surface compaction planes, and pneumatic rolled. To prevent evaporation losses, the surface was covered with 0.3 gal. of emulsified asphalt. The force employed consisted of 2 men at the cement cars, 4 cement truck drivers, 3 on the cement spreader box, 1 on the stabilizer, 1 oiler, 1 blade man, 1 sheepsfoot man, 1 on the nail drag, 1 sprinkler operator, 1 mechanic, 1 foreman and 1 superintendent.[N11]

Asphalt Subsealing

The California Division of Highways has conducted a study of asphalt subsealing of concrete pavements to reduce slab movement, eliminate pumping conditions, and seal the pavement from the bottom side. This led to the following conclusions:

1. The asphalt, after being injected, will cool to subgrade temperature in from 15 minutes to one hour, depending on the thickness of the asphalt layer.
2. Free water under the pavement may chill the asphalt too quickly to permit satisfactory distribution.



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3. The asphalt may be forced into any void beneath the pavement except when free water is present.

4. A lift of 0.05 inch to 0.10 inch should be given to all slabs and lifts up to one-half inch may be given if slabs are low.

5. The deflection of slabs under loads are materially reduced by asphalt subsealing.[P4]

Operating Carrying Scrapers

The work cycle of a carrying scraper consists of (1) load, (2) shift gears and accelerate, (3) haul, (4) spread, (5) turn and (6) return. Rubber tired scrapers can average 14 mph, if the route they travel is kept in shape. A 10 yd. scraper can be heap-loaded in 1 to 1½ minutes (when the dirt spills or windrows, stop loading). Times for the other operations average: Shifting gears and acceleration, 1.0 min; spreading 0.5 min.; turning 0.5 min. This totals 3 to 3.5 min. for all except the travel. If the haul is 1,000 ft. and return, the time for ten yards is 4.6 to 5.1 min. Allowing 10 min. loss per hour, this gives 132 to 118 pay yards per hour.

The loading time of 1.0 to 1.5 min. assumes:

1. That advantage is being taken of any opportunity for downhill loading.
2. That in level terrain passes are made both ways in the cut to save tractor travel.
3. That chain loading (swinging pusher from behind loaded rig to second one pulling up alongside) is practiced where possible to reduce tractor maneuvering.
4. That very tough materials are prepared for scraper loading by rooting.
5. That tractor and rubber-tired equipment operators are experienced dirt men, familiar with the equipment.
6. That the power applied is matched to the job required of it. In the time allotted, one pound of drawbar or rimpull will load about one pound of dirt.[N13]

Self-Supporting Airports

Of 68 airports surveyed by C A A, only 16 reported a profit. It seems certain that airports can be made self-supporting only by obtaining money from spectators by means of admission fees and concessions. La Guardia Field charges 10 cts. admission. A partial list of possible concessions includes hotels, garages, gasoline service stations and parking lots for automobiles, spectator ramps, sky-room dining rooms, cigar counters and newsstands, retail shops for novelty and gift items, barber shops, branch banks, drug stores, bowling alleys, swimming pools, dispensing machines for candy bars and gum, newsreel theatres, taxi and bus drivers' franchises, drive-yourself cars, steam baths and showers, luggage lockers, telephone booths, and telegraph offices.

Most future terminal buildings will provide large window areas, for which the double-pane insulating glass "Thermopane" is suggested, which reduces condensation of moisture on the glass as well as loss of heat.[J1]

Earth Moving On Shirley Highway

In moving 230,000 cu. yd. of earth in one month, for construction of two 24 ft. wide lanes of road over rolling country of clay-gravel, with cuts averaging 15 to 18 ft. deep (one 100 ft.) and lengths of haul from a few hundred feet to over a mile, the contractor assembled two groups of equipment, one for short haul and one for long haul.

For the long haul, most of the excavation was done by a high-capacity elevating grader of new design which cut a strip 3 ft. wide by 18" deep and discharged it by belt conveyor into 13 cu. ft. bottom dump wagons (of which 12 were used) at the rate of a wagonful in less than a minute—682 in one 11 hr. day. A tractor-drawn rooter scarified ahead of the elevating grader; a 12 ft. patrol grader shaped banks of cuts; one 110 hp bulldozer kept the ground leveled for the hauling equip-

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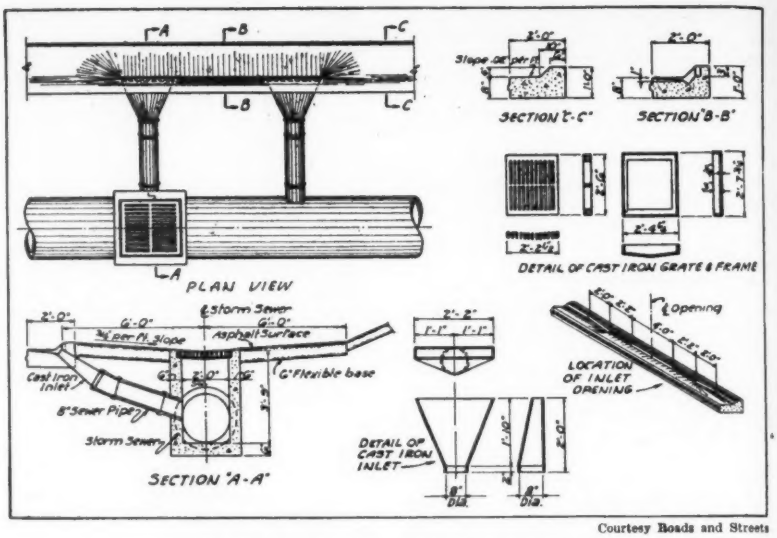
ment, and another spread material on fills; which were compacted by tractor-drawn sheepsfoot rollers.

For short-haul operations he used four 12 cu. yd. carrying scrapers pulled by 110 hp tractors; three 110 hp bull-dozers (one used as a pusher much of the time), a 12 ft. patrol grader, a tractor-drawn rooter, and a tractor-drawn sheepsfoot roller.[E3]

Timing in Power Shovel Work

Correct timing and co-ordination on the over-all job will greatly increase efficiency and add to the life of equipment. If the ground has not been preworked properly for a power shovel, break-downs will result. Overloading or forcing a shovel is a time-losing practice. Timing of transportation sets the pace for a shovel; if trucks serving it are allowed to group, the shovel will alternate overworking and idling. First-class machine operators and fleet operators are necessary.[N21]



Courtesy Roads and Streets

Details of cast iron inlet and typical installation.

Expressway Gutter Inlets

The Fort Worth, Texas, expressways are designed for a 0.02 ft. slope per ft. across and a 4" rolled curb on each side of a 24 ft. pavement. It was desired to provide storm water inlets which would give maximum efficiency at reasonable cost, and several types were designed and full-size models tested. Finally one was developed which seemed best to meet these requirements, and data collected concerning its efficiency and capacity on different gutter grades. It was learned, among other things, that a 1" drop in the gutter in front of the inlet contributed from 10 to 40% to the efficiency. Where the road grade is 0.5%, the gutter flowing 1¼" deep would carry 0.32 cfs, all of which would enter the inlet; and with a 6" per hr. rainfall, this amount would flow off of 85 lin. ft. of pavement 24 ft. wide. On a 2% grade, only 96% of a runoff of 0.63 cfs would enter the inlet (this amount being contributed with a gutter flow 1¼" deep) from 167 lin. ft. of 24 ft. pavement. The cast-iron inlet will be connected to the sewer by an 8" pipe. The cost of two double cast-iron inlets and pipes for a double inlet would be about $28.60.[N18]

MEMO to
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The Federal Airport Act

The Civil Aeronautics Administration recently issued its rules and regulations for carrying out the Federal Aid Airport Program. It uses the terms "Program," the yearly schedule of projects; "Sponsor," one or more public agencies which will have control of the proposed airport; "Applicant," a sponsor or a public agency (such as a State) which acts in behalf of a sponsor (such as a minicipality) in submitting a Project Request or Application; "Project Request," sponsor's or applicant's expression of interest—a "feeler"; "Project Application," a sponsor's or applicant's formal, detailed application for a grant of federal funds; "Tentative Allocation," C A A's notice of allocation of Federal Aid; "Offer," statement of the amount Government will assume; "Grant Agreement," C A A's offer to have Government assume a share of project costs, plus sponsor's acceptance; "Sponsor's Assurance Agreement," the "tie that binds" both parties for a 20-yr. period.

The sponsor files a project request through the District Airport Engineer. If the project is selected, C A A makes a tentative allocation. A project application is then filed with the District Engineer by the sponsor. If C A A approves, the administrator makes an offer, which, if accepted, becomes the grant agreement. After this has been executed, the sponsor's assurance agreement is executed.[N14]

Finishing Dummy Joints

In refinishing the Packard Company's test track, the company is laying over the old track a 6″ concrete pavement 55 ft. wide, with contraction joints 1½″ to 2″ deep every 50 ft. on the tangents. These are doweled with 30″ dowels spaced 18″ centers. Special attention is given to finishing joints. A poured rubber seal is being used, the joint first being blown out with compressed air. Where they were not properly formed in construction, ¼″ wide grooves are cut to a depth of 2½″, using a power grinding wheel operated by air compressor, followed immediately by sealing.[N9]

Controlling Erosion At Culvert Outlets

On Connecticut State highway, erosion caused by discharge from highway culverts is controlled by use of check drains. These are constructed of old bridge planking set in narrow trenches dug across the flow line to a depth of about 3 ft. and extending 5 or 6 ft. into the banks; backfilled with sod thoroughly tamped. The dam nearest the culvert has spillway elevation the same as that of the culvert outlet and a drop of about 2½ ft.; the second dam is set with a spillway elevation 2½ ft. below that of the first dam; and so for each succeeding dam. Thus the distance between dams is governed by the steepness of the slope.[N23]

Bibliography of Highway and Airport Literature

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3. An Easy-to-Use On-the-Job Training Program for Your Highway Personnel. Pp. 17, 29-32, 62.
4. Results of Experiments to Improve Asphalt Subsealing Methods. By H. L. Cooper and W. R. Lovering. Pp. 26-26.

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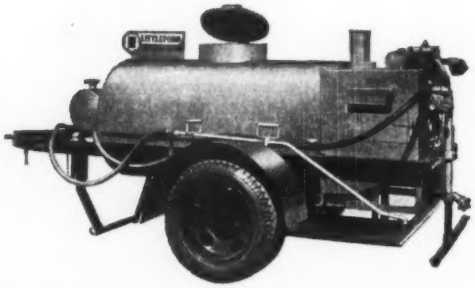
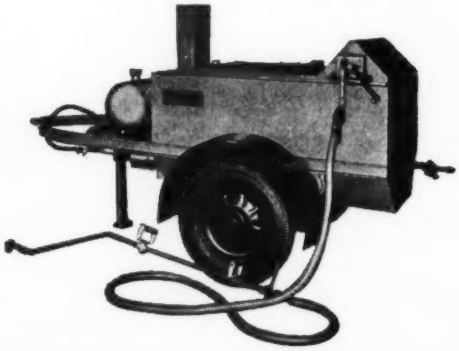


Littleford 101 Utility Spray Tank is combination of three units: Spray bar for spraying, hand spray for patch work, pouring pot outlet for filling cracks.



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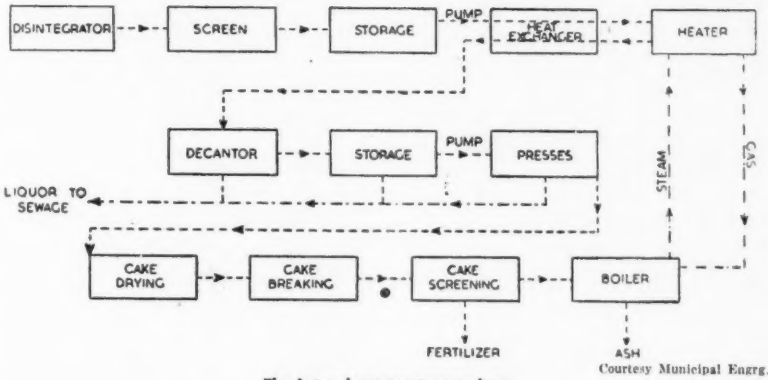
The Sewerage Digest

Heat Treatment Of Sewage Sludge

Luton, England, has been operating a heat treatment plant for over a year (two other such plants were installed in 1939) treating the sludge from over 100,000 population. In heat treatment the sludge is raised to 300° to 400° temperature for 30 minutes, settled for 3 hr., the supernatant withdrawn, and the sludge pressed. Heated sludge settles quickly, when it contains 12% solids. Also it compresses quickly in pressure filters to cake containing 40% to 50% moisture. At Luton this cake is air dried and burned in the furnace that supplies the heat. "Where land is cheap and the population served is small, it seems unlikely that heat treatment would be considered, but where land is expensive or unavailable, heat treatment might well show advantage over other methods."

The sludge is first preheated by passing it through a heat exchanger, then heated further by passing through it steam heated to 500°, 80% of the heat being recovered in the preheater. The steam consumption has been about 0.6 to 0.85 lb. per gallon of sludge treated.[I4]



Courtesy Municipal Engrg.

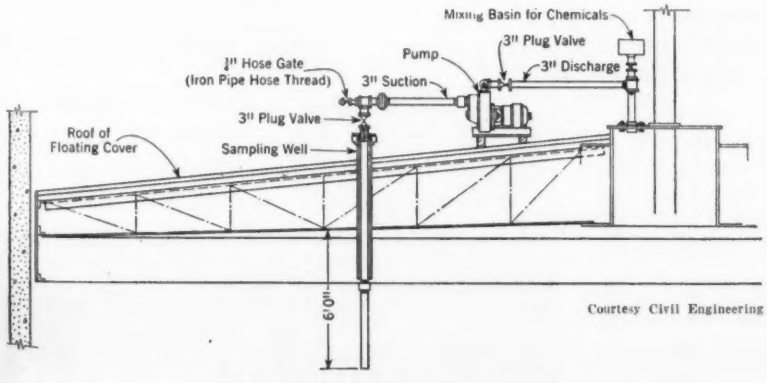
The Luton heat treatment plant.

Designing Sludge Incinerators

In planning incinerators, too little attention is given to the heat release of sludge when it is burned, in terms of Btu's per cu. ft. of firing chamber per hr. Other factors to be considered are the water and ash content of the sludge. The most important part of incineration is the dewatering of the sludge. The author recommends not planning an incinerator until the vacuum filters or other dewatering equipment has been operated for a year, as this allows time for breaking them in and determining the exact characteristics of the sludge normal for that plant.[M6]

Controlling Digester Scum

The digester is the ideal place to dispose of greases and scum. Greases are readily digestible and result in a higher percentage reduction of volatile content than the rest of the solids. Scum should be kept in intimate contact with the liquid contents of the digester, either by positive submergence or by recirculation of digester liquor. This not only introduces to the scum active organisms for promoting digestion, but also tends to raise its temperature, which aids in this. In operating two 65 ft. digesters at a large naval installation, they accumulated 9 ft. of yellow scum, so concentrated that it could not be penetrated with a 2 x 4. Digester liquor, recirculated at the rate of 300 gpm. by a self-priming centrifugal pump and piping (see cut), caused the scum adjacent to the discharge of recirculated liquor to become soft and mushy; then scum from further away floated toward the point of the pump of discharge and became soft, until in a few days the entire scum mass was soft and permeated with digester liquor. Several plants have added ammonium sulfate to the circulated liquor and found it to cause the scum to digest quite rapidly.[L1]



Courtesy Civil Engineering

Recirculating digester liquor through scum.

The Digestion Tank Scum Problem

To maintain favorable digesting conditions in the scum layer, this layer must be kept thin and wet, and well impregnated with digesting organisms; it must be maintained at optimum temperature and proper alkalinity. Keeping it thin and wet may be aided by mechanisms that move the scum across the tank and down into the supernatant; by propellers on vertical shafts that agitate the entire digester contents; by perforated pipes or revolving jets in the scum layer, through which supernatant is pumped; by pumping onto the top of the scum relatively large quantities of supernatant liquor. (Floating materials that will not digest under favorable conditions should be removed.) Any of the above will also keep the scum impregnated with digesting organisms. Recirculating sludge into the supernat-

ant is not desirable as sludge particles may be entrapped in the scum. A temperature of 85 degrees is generally satisfactory, although some oils and greases require at least 95 degrees. The alkalinity or acidity condition should be learned by making pH tests at least twice a week and maintaining the pH at slightly above 7.0. If lime is used, apply it as a solution in supernatant pumped onto the scum.[G3]

The B.O.D. Test of Treatment Efficacy

Studies of Hommon and Theriault have shown the oxygen demand of sewage during the first ten days to be largely a result of biological stabilization of carbonaceous material. After the carbonaceous oxidation is nearly complete, conditions allow the development of a nitrifying flora which oxidizes the ammonia to nitrites and the nitrites to nitrates. This causes an increased oxygen demand and results in a second inflection in the B.O.D. curve. During the conventional 5-day B.O.D. test the oxidation does not proceed into the nitrification stage and only carbonaceous B.O.D. is measured. When B.O.D. tests are run on final effluent a considerable nitrogenous B.O.D. will superimpose itself upon the small residual carbonaceous B.O.D., thus failing to show how much stabilization of this has been accomplished.

The authors have developed, at Sioux Falls, S. D., a procedure for eliminating the oxidation of nitrogenous matter in the B.O.D. test and allowing the measurement of residual carbonaceous B.O.D., using a flash pasteurization procedure. They found that pasteurization or chlorination of effluents from biological treatment will arrest nitrification and allow carbonaceous B.O.D. to be measured, provided a seeded dilution water is used and excess chlorine has been destroyed. Flash pasteurization at 60 degrees to 80 degrees C. with subsequent cooling to 20 degrees has been found to be a satisfactory procedure for destroying the activity of the nitrifying organisms. The measurement of residual carbonaceous B.O.D. without interference from nitrogenous B.O.D. allows determination of plant efficiencies in terms of plant loading.[C2]

Sewage Disposal In South Africa

In Johannesburg, part of the sludge gas is used to produce formaldehyde and cyanide. The latter is used by the gold mining industry and the city expects to obtain from it an income of $80,000 a year. In manufacturing cyanide, purified effluent is used for cooling, acquiring a temperature of 160° to 180° F, and is then used for heating the digestion tanks. Sludge gas was used for running trucks as far back as 1935. It was used in the manufacture of incendiary bombs, and in the production of carbon black. From methane, acetylene is made, and from this are produced synthetic rubber and plastics.

During 80% of the year there is no rainfall in Johannesburg, and separate sewerage systems seem desirable. Also, the streams are mere trickles a large part of the time, there is no such thing as purification by dilution, and effluents of treatment plants must be of a very high quality, hence sand filters should always be used as a final treatment. Since water supplies are limited in quantity, the sewage is very strong.

The main diet of the natives is crushed corn, and much of it passes through the body undigested, which affects the design of digestion tanks. In some plants special traps are used to catch the undigested corn. Temperatures in mines 6,000 ft. below the surface are very high and the night soil collected there is very septic when removed and discharged into the sewers. The sewage flow varies from a daily maximum of 3 times the average to practically nothing (probably there is no ground water to infiltrate).

The cysts of amoebic dysentery, and eggs of the round worm, tape worm, and hook worm are found in the sewage reaching the plant, and in screened sewage, settled sewage, primary filter effluent and humus tank effluent, and in that from activated sludge plants; but none have been found in effluents from

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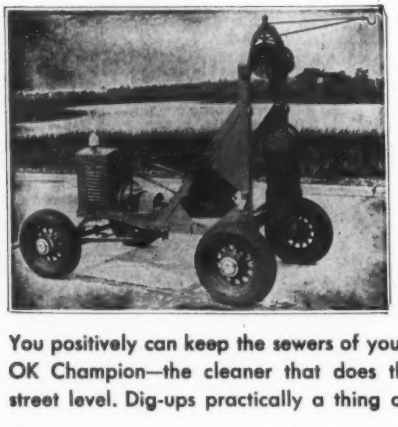

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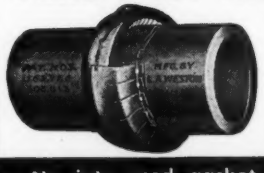

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sand filters or underdrained land filtration areas. Monkeys injected with humus tank effluent during an infantile paralysis epidemic developed paralysis while those injected with sand filter effluents did not. It is likely that in South Africa the slow sand filter will in future be a compulsory adjunct to any sewage works from which the effluent is to be discharged into a stream or is to be used for irrigation on land on which crops for human consumption may be grown.[D3]

Controlling Filter Flies

The Fort Jackson, S. C., treatment plant contains four beds of single-stage high-rate filters containing 5 ft. of 2½" rock; 4-arm rotary distributors; dosage rate based on sewage flow is 12.5 mgad. As the drill field and plant building are only a few feet away, fly control was imperative, which is effected by flooding. At first, all four filters were flooded for 24 hr. at the same time; this killed the flies, and also the effluent. Then flooding one at a time for four consecutive days was tried, with little improvement. On the theory that the washing action rather than drowning was the effective feature of flooding, the flooding period was shortened to two hours. Fly control was excellent; enormous number of larvae were washed out. Then the position of the distributor spray plates was so changed as to produce the heaviest possible surface washing action. The only immediate effect was to make the filter surface a bright green, but as the filters adjusted themselves to the new conditions, flooding frequency was decreased and filter performance and all-over plant efficiency improved.[H2]

Mosquito and Fly Control

Insects of sanitary importance can be controlled by proper use of DDT; by intelligent use of newly developed hand and power insecticide applying equipment; well directed and coordinated local, state and federal programs; public health educational programs; and continued operational and fundamental investigations designed to improve insect control techniques. Measures for eliminating fly breeding places include proper garbage collection and disposal; elimination of dumps; proper storage and disposal of manure; use of incinerators or sanitary fills; and installation of sanitary privies. Use of DDT is not a substitute for these but is an extremely valuable supplementary measure.

For control of mosquitoes, both disease-transmitting and pestiferous, it is desirable to eliminate their breeding places by physical measures where practicable. Underwater vegetation cutters and herbicides are useful in certain situations for eliminating growths where *anopheles* breed. Control of malaria mosquito breeding in impounded water is increasing and more mechani-

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cal equipment used—power saws for felling trees, bulldozers for reservoir clearance, and devices for distribution of larvicides by hand, boat, land vehicles, and airplanes. DDT can be used prophylactically as an adulticide and a larvicide. Dispersed as mists or aerosols, it helps in the economical control of flood-water and salt-marsh mosquitoes. Its use as a mosquito larvicide will reduce application costs at least 70% as compared with cost of other larvicides, as very minute quantities are required.[X1]

The Water Hyacinth in Sewage Utilization

Sewage sludge as fertilizer is lacking in potash, which, with much of the nitrogen and phosphate, is carried away in the clear plant effluent. Water hyacinths absorb large quantities of these salts, and if they are composted with sludge they add these salts to the resulting fertilizer, and also supply moisture to aid fermentation, since they contain 93.4% water. In a test in South Africa, 96 tons of water hyacinths were grown per acre per month in water receiving the sewage of a city, giving 2415 lb. of organic nitrogen per year, 1917 lb. of organic phosphorus, and 3300 lb. of organic potash. During its growth the plant not only withdraws dissolved organic matter from the sewage, but also gives off oxygen, both of which tend to purify sewage effluents. The author suggests raising water hyacinths and composting them with sludge as a part of sewage treatment.[I5]

Treating Phenolic Wastes

The Dow Chemical Company's Midland Plant treats about 75 mgd. of waste waters, of which 25 mgd. are phenolic. The general wastes pass through a grit chamber cleaned by a moving dredge pump; then through a 200 ft. diameter clarifier; then through aeration tanks and secondary clarifiers. More than 80% of the BOD is removed.

Phenolic wastes are pumped to a clarifier, where oils are removed by settling and skimming. The wastes then go to trickling filters containing 10 ft. of blast furnace slag, by which more than 80% of the phenolic matters are removed. The effluent then passes through an activated sludge plant. There results a 99% removal of phenols by the whole plant.[H1]

Biological Detection Of River Pollution

The article under this head in the December Digest was erroneously credited to the Health Bulletin of the Wisconsin State Board of Health, instead of to Municipal Engineering (I-1) as it should have been. An article from the Wisconsin Health Bulletin indicated in the Bibliograpy as X-16 should have been X-26.

Scum Breakers

The use of scum breakers in sedimentation and digestion tanks prevents the accumulation of sludge. This article describes some American and German types, some of the latter differing from any made in this country—rotating heating coils, nozzles, and others.[P3]

Bibliography of Sewerage Literature

D *The Surveyor (England)*

December 6

4. Utilization of Sewage Sludge as Fertilizer, Abstract of report of Federation of Sewage Works Ass'ns. P. 947.
5. Filtration of Sedimented Sewage Diluted With Bacteria Bed Effluent. Pp. 949-951.

December 13

6. Filtration of Sedimented Sewage Diluted With Bacteria Bed Effluent. Pp. 969-971.

E *Engineering News-Record*

December 26

2. Where We Stand on Pollution Control. Pp. 78-79.

January 9

3. Faulted Rock Passed by Grouting on Copenhagen Sewer Tunnel. By K. Pilgaard. Pp. 70-72.
4. Machine Grouts Joints in Trunk Sewer. By C. S. Seabrook. Pp. 80-82.

G *Water and Sewage Works*

December

4. Gary Completes Cycle on the Grand Calumet. By W. W. Mathews. Pp. 455-460.

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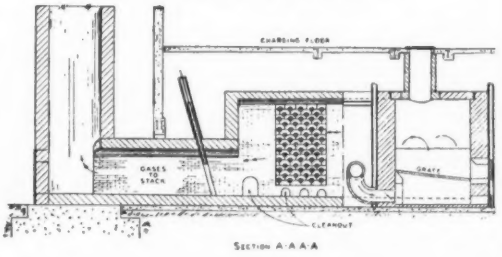

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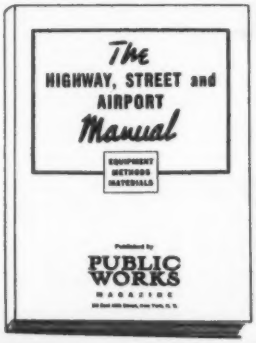

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5. Wool Scouring Wastes Treated by New Chemical Process. By Harry A. Faber and Paul F. Howard. Pp. 467-473.
6. A Plea for Sound Economy in Stream Pollution Abatement. By W. J. Eldridge. P. 494.

H *Sewage Works Engineering*

January

5. Sewage Treatment in State Institutions. By Wm. L. Edwards. Pp. 11-12, 28.
6. Control of Odors and Mosquitoes in Storm Drains. By A. A. Appel. Pp 13-16.
7. When Grease Interferes with Plant Operation. By Wm. T. Field. Pp. 16-17.
8. Incodel Proves Effective in Interstate Pollution Control. By R. C. Beckett. Pp. 18-19.
9. Multiple Units for Operating Flexibility. By Kenneth H. Morkert. Pp. 20-21.
10. Recirculation of Digester Scum Results in Effective Control. P. 24.
11. Distilleries to Salvage Wastes by Evaporation of Stillage. By George L. Hall. P. 25.
12. Operation of Vacuum Filters Reviewed in State Handbook. P. 26.
13. The Operation of Grit Chambers. Pp. 33-34, 38.

I *Municipal Engineering (England)*

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2. Experimental Work at the Northern Outfall Works of the London County Council. Pp. 275-276, 283.

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3. Sewage Disposal at Coventry. Pp. 296-297.

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4. Heat Treatment of Sewage Sludge. By S. C. Evans and F. W. Roberts Pp. 305-308.

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5. Activated and Digested Sludge in Agriculture and Horticulture. By Albert Howard. Pp. 325-327.

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6. Prevention of Pollution in the Tame Basin. By H. Clay. Pp. 342-343.

J *American City*

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1. Allegheny County Tackles Sewage Treatment Problem. Pp. 84-85.
2. St. Louis Studies Waste Collection. Pp. 96-97.

L *Civil Engineering*

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1. Digester Scum Controlled by Liquor Recirculation. By Henry E. Schlenz. Pp. 35-36.

P *Public Works*

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3. How Scum Breakers Aid in Sludge Digestion. By J. J. Gilbert. Pp. 18-19, 38.
4. Illinois City Constructs Combination Pier and Sewer. By Robert L. Anderson. Pp. 27-28.
5. Allegheny County Sanitary Authority Progress and Plans. By John F. Laboon. P. 33.

X *American Journal of Public Health*

1. Postwar Control of Flies and Mosquitoes on Public Health Programs. By Mark D. Hollis and Herman L. Feilton. Pp. 1432-1436.

Manual on Sewage Sludge Utilization as Fertilizer

The Federation of Sewage Works Associations has issued a new manual "Utilization of Sewage Sludge as Fertilizer." This 120-page treatise constitutes an authoritative evaluation of the advantages and limitations of sewage sludge as a soil conditioner for agricultural purposes. Soil requirements; the contents of fertilizer elements in all types of sewage sludge; experimental results; methods of processing and applying sludge for soil conditioning purposes; hygienic aspects; economic factors—all of these considerations are covered in detail. There are many analytical and statistical data. A bibliography of 251 references is also included.

The original draft was compiled by a subcommittee consisting of A. H. Niles, Superintendent of Sewage Treatment at Toledo, Ohio, as chairman; Dr. Willem Rudolfs, Chief of the Department of Water and Sewage Investigations, New Jersey Agricultural Eperiment Station; L. W. Van Kleeck, Principal Sanitary Engineer of the Connecticut Department of Health; F. W. Gilcreas, Director of Laboratories of the New York State Department of Health and T. C. Schaetzle, Superintendent of Sewage Treatment at Akron, Ohio. The final manual was collated and prepared for publication by Langdon Pearse, Sanitary Engineer of The Sanitary District of Chicago; Dr. F. W. Mohlman, Director of Laboratories of The Sanitary District of Chicago and W. H. Wisely, Executive Secretary and Editor, FSWA. The publication was prepared under the direction of the Federation's Committee on Sewage Works Practice, of which Morris M. Cohn of Schenectady, N. Y., is chairman.

Copies are available from the Federation of Sewage Works Associations, 325 Illinois Bldg., Champaign, Ill., at 75¢ per copy to Federation members and at $1.25 to non-members.

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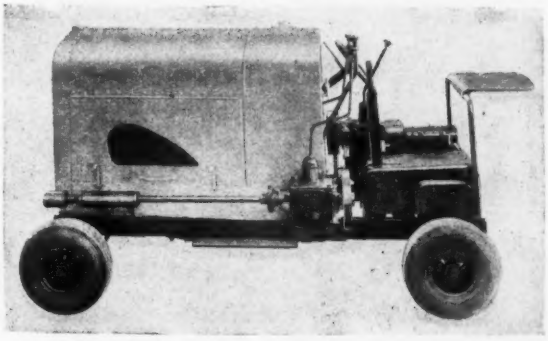

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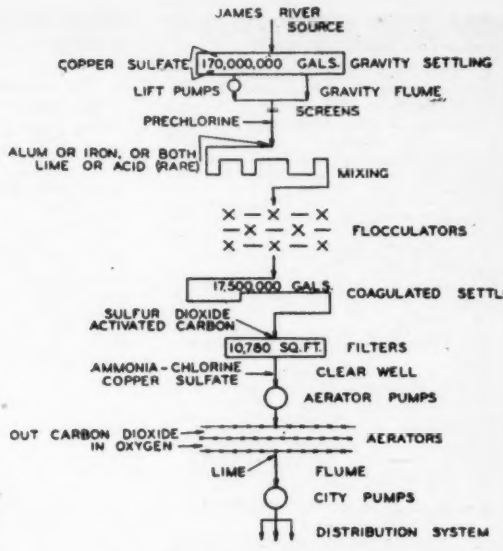


Sequence of treatment procedures at Richmond

Courtesy Pa. W. W. Op. Ass'n

RICHMOND, VA. WATER PURIFICATION

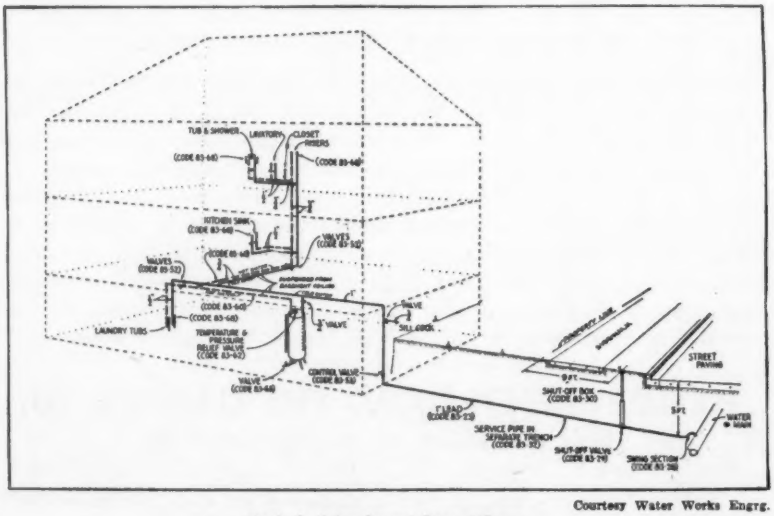
Delivering Satisfactory Water

Delivering water of excellent quality into the distribution system does not insure that such water reaches the consumer. It may, and usually does, depreciate due to chemical reactions and to living organisms in the mains. Richmond, Va., takes unusually thorough precautions to prevent this. The water is so super-prechlorinated that even after 14 hrs. in settling basins, dechlorination by sulphur dioxide is necessary before filtration. The water is sterile before filtration. They employ double coagulation, alum in summer and iron in winter. (Some waters are most effectively coagulated by use of both together.) The pH of the treated water is elevated or depressed when either is desirable. Finally, activated carbon is applied directly to the filter surfaces. As a result of these advances, the water before filtration is better than that formerly delivered to the system; filter runs average more than 120 hr., the filters are clean, sterile and have no mud balls or cracks, and pass 3 gal. per sq. ft. per min. as efficiently as when delivering less than 2.

There remained the conditioning of the mains. When this treatment started and the chlorine reached distant points in the distribution system the water became undrinkable; so the chlorine dose was reduced and then increased gradually for several months until there was a residual of 1 ppm. at the entrance to the distribution system. A slight phenolphthaline alkalinity is provided, by adding lime to the water immediately after post-filtration aeration, to help protect the ferrous parts of the system and discourage the growth of many undesirable forms of life.

Modifications have been made in the mains to eliminate a habitat for bacterial life, to separate the water in the mains and services from ferrous materials, and to cause the water to reach the consumer in the minimum possible time. Lead-tipped rubber gaskets have been substituted for hemp or jute, and mechanical joints are used. Pipes are lined with emulsion-filled cement, and copper services are used. To prevent water standing long in oversized mains, "service headers" (pipe not larger than 3") are used in residential zones where larger pipe is not necessary.

The water used in flushing and wasted has been reduced to less than 1/3. Neither water officials nor consumers think all this too expensive, considering the great improvement in the quality of the water; and even greater improvements are expected.[X16]



Courtesy Water Works Engrg.

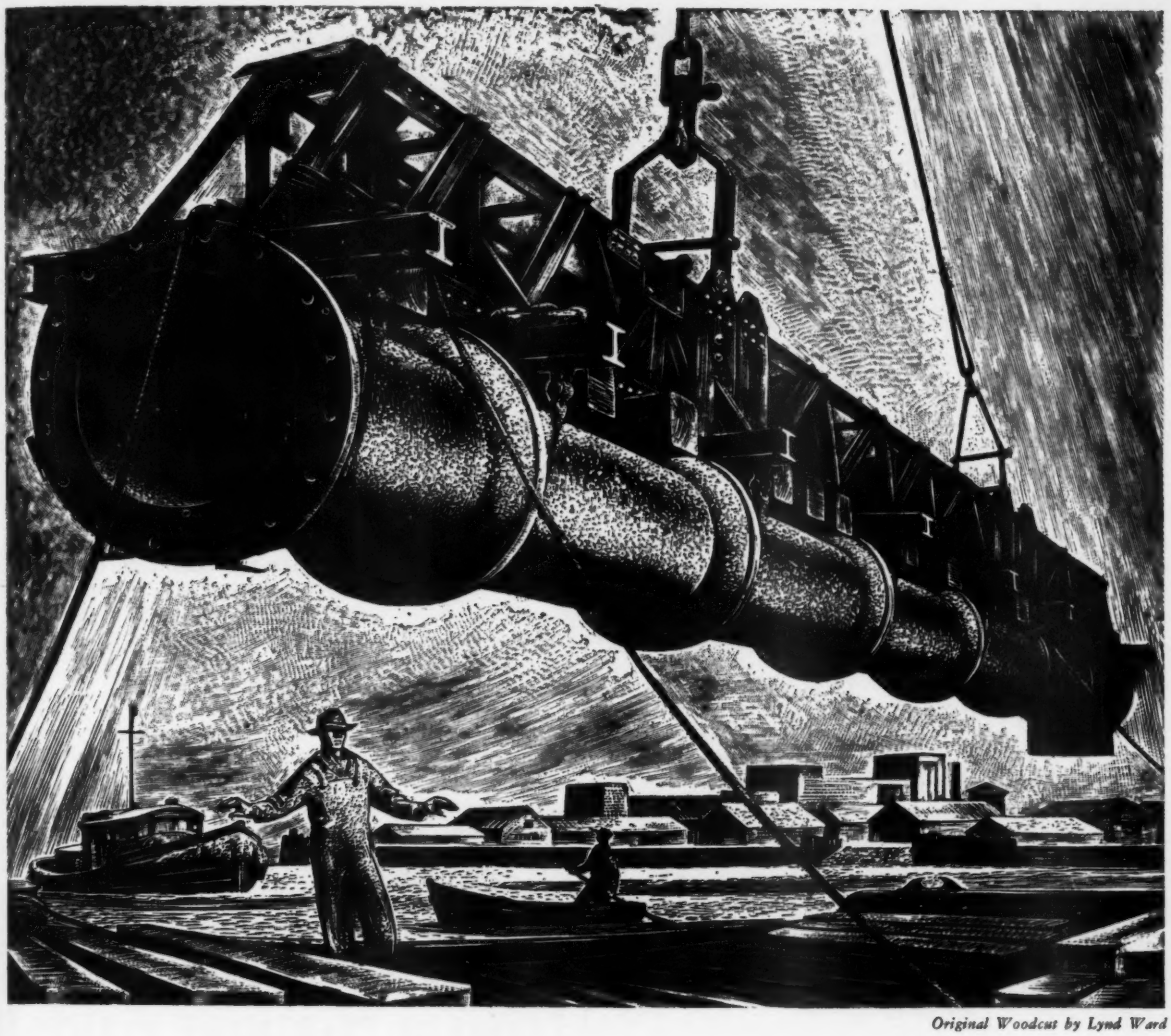
Typical piping layout for residence.

Plumbing In Buildings

Data on the quantity of water that flows through the various water supply pipes in buildings vary widely, and therefore the quantities to be planned for in designing a given plumbing system are uncertain. An ideal condition in a downfeed riser supplied from a roof tank would be to have the friction loss per floor exactly equal to the pressure gained, or about 4 lb.; the loss depending on the size of pipe and amount of water used on each floor. In water supply plumbing (a) Liberal sizing of the mains and risers will help greatly. (b) Liberal sizing of the branches may cause trouble. (c) When liberally sized branches are used, the risers, mains and tanks should be increased accordingly. (d) With proper care the risers and mains need not be made so large as to make the cost excessive. (e) To base the design on an assumed probability of simultaneous use may be dangerous.

In large multiple-floor buildings the percentage of simultaneous use of the various fixtures can be approximated as $\frac{224}{F+2} + 10$, where F is the number of floors supplied from the riser at the point in question, counting from the ground for an up-fed system and top floor in a down-fed.

The Chicago code requires that all house piping be of such size that a full volume of water can be discharged into



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At least one-inch piping must be used in the building to a point from which not more than two ¾-inch connections are taken, and no ¾-inch pipe shall exceed thirty feet in length. The one-inch minimum applies to premises where the combined area of all water openings does not exceed five times the area of a one-inch pipe. Lines to and from the hot water tank must be at least ¾-inch, with a control valve on the cold water supply.[F5]

Grouting Limestone Dam Foundations

Experiences in construction of dams by the Tennessee Valley Authority has demonstrated that gravity type dams may be founded on limestone satisfactorily, provided that proper methods of excavation, cavity filling, and grouting are employed. At the Fort Loudoun dam, solution cavities were found at depths as great as 300 ft. below the original ground surface and 260 ft. below the water table. It was demonstrated that structural deformational features rather than rock solubility often control the depth and extent of weathering. At one point, cavities were mined to a depth of 220 ft. and filled with concrete. The cavities were primarily controlled by solution along faults, joints and bedding planes. At the Douglas dam, the dolomitic limestone was highly cavernous and where the caverns were overlain with sound rock they were excavated, cleaned and backfilled with concrete, supplemented with intensive grouting over the entire foundation.

It seemed obvious that the ground water (1) finds its way into the exposed ends of the previously formed channels developed along such structural weaknesses as bedding planes, faults, and joints; (2) starts its migration along the strike and down the dip of these conducting channels in irregular circuitous paths to a depth determined by the hydraulic head, by the solubility of the rock, and by the structural weaknesses; and (3) resurges upward to the point of discharge. The flow and resulting creation of cavities proceed downward until an upward or lateral movement is less resistant than continued downward flow. Thus, a system of both vertical siphons and low-angle inverted siphons develops, one group below the other, the depth dependent primarily on the differential head.

The methods employed in drilling, excavating and grouting are described in detail.[K1]

Metering Program At Aurora, Ill.

There are approximately 12,250 meters in use in Aurora, Ill., owned by the consumers. In 1941, 52% of the water put into the distribution system was unaccounted for, and the meter situation was investigated. It was found that most of the domestic meters had never been removed, some of them for 40 yrs.; also that the majority of them were the piston type. The department decided to remove and test all meters which have been in service 7 years, replacing the removed meter with a new or repaired one, of the most suitable size. In doing this, the department transfers its title to the new meter to the property owner, and the latter transfers his title to the old one to the department. About 50% of the meters brought in are scrapped as not being worth repairing. Many of the old services are corroded and the pressures low, which causes low registration with piston-type meters. By replacing these with disc meters, registrations increased up to 400% in many cases. In 1945, 11% less water was pumped than in 1944, costing $4,500 less, but revenue from meters increased $6,500. "It is obvious that when the balance of our meters, which is approximately 80%, are replaced, the increased revenue can represent a staggering amount.[F4]

Contract for A Deep Well

In preparing specifications for a deep well contract, the following items should be considered:

a. Delivering and removing equipment. b. Drilling and setting outer cas-

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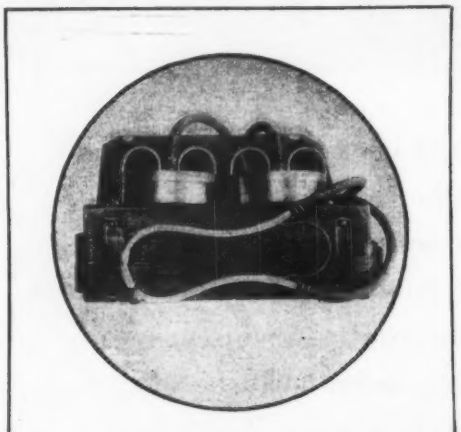

When hunting leaks, you need not be an expert marksman if you use the A/H LEAK LOCATOR. It will lead you to that underground leak in a jiffy. No hit-and-miss excavating, no unnecessary resurfacing of the street.

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Pipe Locators	Dipping Needles	Leak Locators	Pipe Phones
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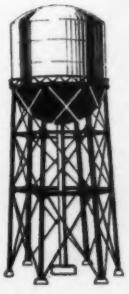

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ing to rock, including furnishing casing. c. Drilling and setting inner casing and furnishing casing. d. Sealing between casings and rock, method and material. e. Depth of inner casing below outer casing. f. Drilling, including furnishing casing, in sand and gravel formation. g. Cleaning rock hole (by wire brushing or other specified means). h. Developing, agitating and surging. i. Furnishing and setting test pumps, and type of test pump. j. Number of hours of testing. k. Setting screen (if gravel well). l. Cost of holding equipment waiting screen. m. Pump foundation. n. Materials, fuel, water, cement, casing water in starting and for equipment. o. Disposal of waste pumping water. p. Disposal of waste from drilling, and method of disposal. q. Accessibility of site to nearest road. r. Rights-of-way to reach site. s. Protection of public rights and property damage. t. Sterilizing of completed work. u. Samples of materials encountered in drilling. v. Required log of drilling and penalty for not keeping same. w. Method of plumbing hole and cost of same. x. Gauging for required fullness of hole.

If all of these are provided for in the contract, the contractor need not include allowances for uncertainties in his bid, which should be lower than if he had to gamble on unknown factors.[Y3]

Safety in Operating

Accident insurance does not relieve a manager of his responsibility for the safety of employees. Executive recognition, interest, support and participation are the foundations of any safety program. Such program includes improving the environment and also human behavior. The former includes elimination of unsafe physical conditions and also unpleasant or unhygienic conditions. Next in order is providing personal equipment — gloves, helmets, masks, etc. Influencing human behavior is best accomplished by means of a safety committee of the men themselves. The American Water Works and Electric Co. has each local manager appoint a safety committee of at least three workmen whose duties entail a monthly inspection of all buildings, equipment, construction and repair projects, tools, vehicles, protective devices and other physical properties, and are responsible for the investigation of accidents and the education of their fellow employees in both first aid and safety practices. The personnel of this committee changes at quarterly intervals.

A meeting of the Safety Committee is held with the local manager after each inspection tour to discuss the findings and determine a course of corrective action. During the winter months, the entire force is invited to attend each monthly meeting, and a program of outside speakers, moving pictures and a lunch is arranged. Carefully selected posters, bulletins and pamphlets are distributed and posted on special bulletin boards, and an Intra-plant Contest Report, based on the

FOR SPEEDY UNDERGROUND PIPING INSTALLATIONS... Greenlee Pusher

Installing 25 feet of 4-inch drain pipe under both a railroad and a paved street could be a mighty tough job as you well know. But, as shown above, the operation was a simple one for The Texas and Pacific Railway Company . . . they used a GREENLEE Hydraulic Pipe Pusher!

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Greenlee Tool Co., Division of Greenlee Bros. & Co., 2042 Columbia Avenue, Rockford, Illinois.

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TO CITIES LIKE SIOUX FALLS, S. D.

Sioux Falls, S. D., is a typical American City. like many other smaller towns, it is growing into a much more important distribution and manufacturing point. Water for further growth was needed in large—but economical quantities. The choice was a Layne Well Water System that is now producing a million gallons daily.

Sioux Falls is not burdened by high operation cost, and furthermore there will be very little—or perhaps no repair expense for years to come.

Layne Well Water Systems, used and famous the world over, are engineered for heavier duty than ever called upon to perform. Such extra ruggedness and remarkably fine quality makes them an unmatched investment for any city or industry. These Well Water Systems are built in a wide range of capacities suitable for present needs and future growth. Space requirements are small and installations can be completed in a matter of weeks.

For further information, literature, etc., address Layne & Bowler, Inc., General Offices, Memphis 8, Tenn.

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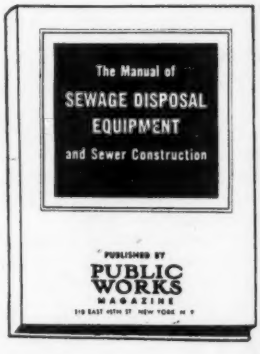

A great help in working up plans for sewage disposal

The new 1946-47 edition of The Sewerage Manual is now off the press. This new Manual describes every type of equipment and material available for use in sewage disposal and sewer construction. It is used by leading sanitary engineers everywhere when preparing plans. It is the standard source of unbiased information.

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monthly accident incidence, is also posted.

Utility men and meter readers report any substandard or dangerous conditions at meter installations, valve boxes and other facilities, and these are corrected without delay.[A12]

Disinfecting Water Mains

By a new method introduced by the author, newly laid mains, which were calked with chemically treated paper instead of jute, are thoroughly flushed until the water at the far end of the line is free from particulate matter, and then chlorine gas or a solution of hypochlorite is introduced and maintained under normal operating pressure and conditions, and a free chlorine residual of 0.5-1.0 ppm. is maintained for a period of six hours. A clean pipe surface is essential. "When the batch method of chlorination is used, the opportunities for penetration into the many interstices of the pipe surface and joints are at a minimum. The author has demonstrated that chlorine residuals as low as 0.1 ppm., when introduced and maintained under normal flow conditions, sterilized newly laid and repaired water mains in a relatively short period of contact." Sufficient chlorine gas is introduced under pressure while the water is flowing to produce an initial free chlorine residual of 0.5 to 2.0 ppm. Samples of the water should be tested for chlorine content and bacteria after sterilization, at intervals of ½, 1, 2, 4, 8-10, 24 and 48 hrs. Meantime the water can be used for industrial consumption but not for drinking.[A3]

Depletion of Ground Water

Accelerated rates of pumping during the war have brought problems of ground water development that normally might not have arisen until several years later. Declines in ground water level have resulted that have led to fears of complete exhaustion of aquifers. But localized dewatering does not necessarily indicate any over-all depletion of the aquifer, and it may be possible to secure relatively high yields at locations removed from the over-development. Generally, reports of excessive lowering of the water table and declines in well yield indicate local over-development of the reservoir, but do not necessarily indicate broad regional over-development.

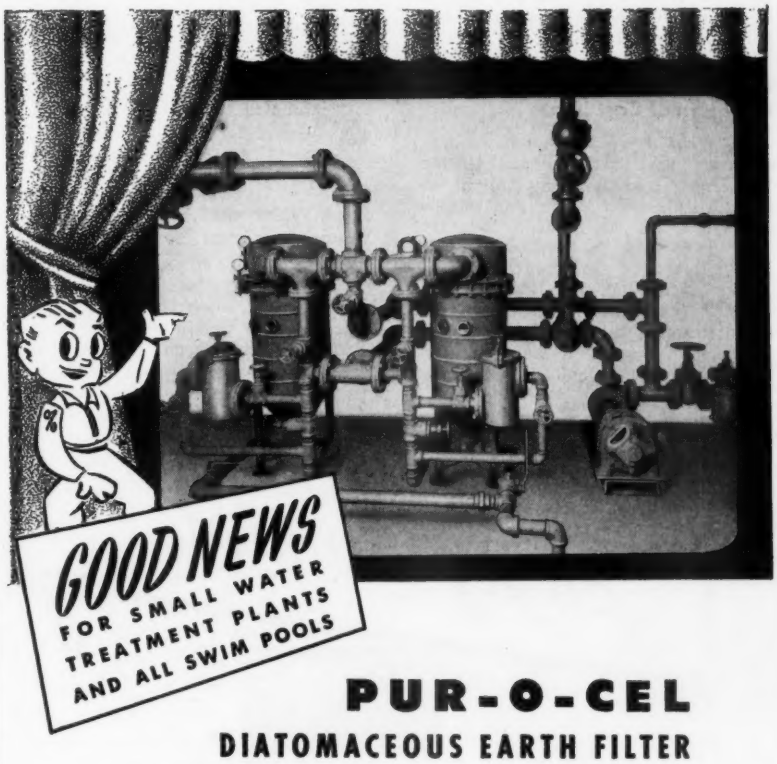
The State of Michigan Geology Division plans to observe wells strategically located in most of the important aquifers and enlist the cooperation of waterworks operators, well drillers and engineers and others in making periodic measurements of the fluctuation of water level in these wells; and from these data to study the significance of changes in storage in the reservoirs and correlate these changes with other factors, such as precipitation, pumping and stream flow.[A8]

Filtering Low-Alkalinity Water

Waters treated in the alkaline range filter better than those coagulated in the acid range. Where the water is of low alkalinity, the beneficial reactions in the filter can be produced and controlled if an active alkalinity is added in the correct amount and at the right point. A treatment has been developed which consists of adding a small amount of lime (usually 4.16 to 8.33 ppm.) to the water just as it leaves the settling basins to flow to the filters, providing a filtered water with a pH of 7.5 or 7.6. The lime added tends to precipitate as the hydrate instead of going into solution, forming an active and flocculent mat on the filter, which acts to precipitate those substances present in the water which would produce acid reactions and contribute to the corrosive activity of the water. The amount of lime added should be below that which would produce a coating of calcium carbonate on the sand. There will be phenolphthalein alkalinity on top of the filters but it should not pass through them.[A9]

Annual Reports of Water Departments

The majority of the best prepared annual reports of waterworks departments reach an average of only one out



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of 3,000 to 3,500 persons in the local areas served. The reason is that the majority of departments consider that their chief value is to serve as media for exchange of information within the industry, as stimulants for better record systems, and as funds of statistical information for the guidance of management. Few consider their value as instruments for improving public relations. The report of the Kansas City, Mo., water department is made readable; includes descriptions of the plant and its equipment, generously illustrated with drawings and photographs. Summarizations of results are given by annual totals, not monthly ones. All irrelevant statistical data are excluded and relevant data given in summary form only. These reports are distributed locally so that they reach one out of 70 persons in the community.[A11]

Graphitic Corrosion of Cast Iron

In graphitic corrosion of cast iron, electro-chemical action occurs between the ferrite and the graphite in the structure, the iron going into solution as an iron salt, part of which is carried away in suspension in the water, the porous mass of carbon retaining its original shape but with little strength. Metallurgical research has shown that the strength of cast iron depends upon the amount, shape and distribution of the graphite and upon the properties of the matrix. Modern alloy cast iron is dense, has a tensile strength of 50,000 to 60,000 psi (as compared to 20,000 of that used 50 years ago), and has a much greater resistance to corrosion, especially graphitic corrosion. The additions of small amounts of manganese, chromium, molybdenum or copper effects this. If such iron, with its greater strength, is used, castings can be made lighter and will last longer. Tentative specifications of the ASTM, A 126-42 provide for

Total carbon	3.00% ± 0.15%
Silicon	2.00% ± 0.25%
Manganese	0.75% ± 0.15%
Nickel	1.05% ± 0.15%
Sum of chromium and molybdenum	0.35% ± 0.05%
Phosphorus, maximum	0.30%
Sulfur, maximum	0.12%
Tensile strength, minimum	40,000 psi.

These have already been adopted by Newark, N. J. for the cast-iron parts of valves.[A13]

Joint Water and Sewer Accounts

The financing of sewage works by sewer rentals has become popular during the last few years. Certain general procedures in administration and operation of this seem to have been crystallized by experience under our statutory laws. The problems involved in billing and collecting sewer and water charges are so similar, and the grouping of the two may effect such economies, that control under one administrative head seems logical and advisable.

Simplicity in rates is very important. On the joint bill, the water item is the primary one and the sewer charges should be as inconspicuous as possible, but be clear and perfectly understandable. Penalties or discount practices that are applied to water bills should be duplicated in principle with sewer rentals. It is general practice to require that sewer rentals be paid with the water charges when both are billed at once, and to turn the water off if the sewer rental charges are not paid. If some use the sewers but have their private water supply, special arrangements will have to be made for their rates.

This article, a panel discussion, gives details of the plans adopted at St. Paul, Detroit, Toronto and other places.[A5]

Controlling Water Quality

To control the quality of the water delivered to the consumers, Baltimore eliminates cross connections; applies copper sulphate to distribution reservoirs and automatically chlorinates effluents from them; the latter preventing secondary degradation in the mains.[P3]

BUILDERS *Propeloflo* METER

Builders Propeloflo Meter is a simple, self-contained totalizing meter that bolts into the line as easily as a short length of pipe. Direct reading in gallons . . . it requires no other instruments or electricity. These features, plus the accuracy and low head loss of streamline Venturi design, make Builders Propeloflo Meter ideal for metering main lines from 2" to 36".

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2. Electronic Pipe Finding and Leak Locating. By Curt R. Fisher, Pp. 1330-1334.
3. The Disinfection of Water Mains. By Austin N. Heller. Pp. 1335-1341.
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8. Relation of Geology to Ground Water in Michigan. By Norman Billings. Pp. 1373-1379.
9. Water Purification and Corrosion Control. By C. E. Trowbridge. Pp. 1380-1382.
10. Indiana Retirement Fund for Public Employees. By Ross Teckemeyer. Pp. 1383-1384.
11. The Waterworks Annual Report. By Melvin P. Hatcher. Pp. 1385-1386.
12. Safety—An Operating Problem. By Harold F. Webb. Pp. 1387-1391.
13. Graphitic Corrosion of Cast Iron. By Laurie M. Leedom. Pp. 1392-1397.
14. Rules Governing Stations in the Utility Radio Service. Pp. 1398-1407.

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1. Additions to Springfield (Mass.) Transmission Mains. By Peter C. Karalekas. Pp. 332-343.
2. Problems in Disposal of Sludge and Wash Water for Connecticut Water Filtration Plants. By Frederick O. A. Almquist. Pp. 344-362.
3. Free-Residual Chlorination at the New Haven Water Company. By S. Jacobson and M. S. Wellington. Pp. 363-388.
4. Cement Linings for Cast-Iron Pipe. By Thomas F. Wolfe. Pp. 389-394.

E *Engineering News-Record*
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6. Water Treatment at Yuma, Ariz. Aimed at Reduction of Silt Content. P. 82.
7. Self-Sufficient Pipe Trailer Gives Pick-up and Delivery Service. P. 93.

F *Water Works Engineering*
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3. Drifting Sand Provides Ground Water Supply in Australia. By Len Barsdell. Pp. 1442-1443.

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4. Unusual Meter Removal Plan at Aurora, Ill. By Carl Duy. Pp. 1500-1501, 1507.
5. Designing Water Supply Piping for Buildings. Pp. 1505-1507.
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4. Solving Water Plant Operation with Activated Silica. Part III. By Harold R. Hay. Pp. 479-482.
5. Modern Practices in Municipal Water Softening. By S. B. Applebaum. Pp. 485-490.
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2. Hydraulic Controls for Water Purification. P. 309.

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3. Notes on the Location of Underground Services. By Robert Bruce. Pp. 323-324.

J *American City*
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1. Good Water for Gloversville, N. Y. By W. F. Davies and R. S. Taggart. Pp. 76-77, 133.
2. Dyersburg, Tenn., Builds Iron Removal Plant. By Ellsworth L. Filby. Pp. 78-79.

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3. Results of the Control of Water Quality in the Baltimore Distribution System. By Edw. S. Hopkins and S. Everett Edwards. Pp. 20-24, 28.

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9. Determination of Water Hardness. By John J. Shank. Pp. 57-66.
10. Result of Maintaining High Chlorine Residuals in the Distribution System at Easton, Pa. By J. O. Fulmer and W. B. Johnson. Pp. 67-73.
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16. Water Quality Depreciation in Distribution Systems. By Marsden C. Smith. Pp. 98-105.
17. The Increased Necessity for Stand-by Service as Indicated by Fires, Floods, Wars and Strikes. By John H. Murdock, Jr. Pp. 106-114.

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1. The Maintenance of Pumping Machinery. By F. Wood. Pp. 8-11.

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2. Applying Copper Sulphate to Reservoirs. (From New York State "Water Works News") Pp. 8-9.
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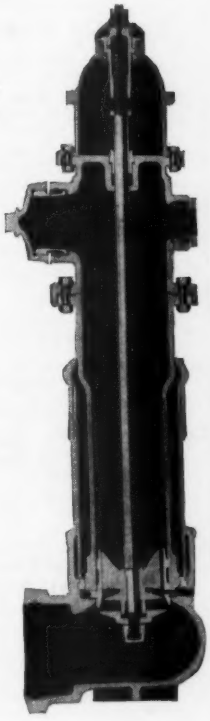

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The colder the weather, the tougher the job of fighting fire. But so far as hydrant service goes, no fireman ever worries about a Mathews.

Mathews Hydrants are independent of the weather. No machined part is exposed to water.

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Letters to the Editor

Sure Thing!

Dear Sir:

An editorial entitled "Pot-Holes and Post-War Facts" which was in the July 1946 issue of your magazine has come to our attention.

May we have your permission to reprint it with credit in manuals circulated among our industrial pump dealers and salesmen?

Duncan G. Hudson
Sales Manager
Industrial Pump Department
JOHN BEAN MFG. CO.

Jan. 7, 1947.

Home Sewage Disposal

Dear Sir:

The membership of the Clay Sewer Pipe Association commends your editorial of October, 1946, suggesting inquiry into the need for large capacity tanks to treat sewage locally at residences and summer camps. Septic tanks have been produced by clay pipe manufacturers for more than half a century and the number of complaints regarding operation of such tanks is so infinitely small as to be completely negligible. There are innumerable cases where such tanks have been reported to operate successfully after decades of use. Many tanks now in use for local treatment of domestic sewage serving a single residence or small source of flow have volumetric capacities which are small compared with the current minimum requirements of state health boards. Most such regulations stipulate 500 gallons as a minimum permissible capacity below water level. This standard apparently was established arbitrarily, based on theoretical considerations and were adopted, so far as this industry has been able to learn, independent of reference to actual operation experiences with smaller tanks.

It is doubtless true that further research investigations will develop improvements in the design features of such tanks. As such improvements are introduced, operation will be improved. However, it seems prudent, as suggested in your editorial, to review current standards for septic tanks and other types of treatment units with the view of determining whether or not satisfactory operation can be depended upon in tanks having less than 500 gallon minimum capacity. It seems logical that this minimum can be reduced appreciably without adversely affecting quality of treatment.

The Clay Sewer Pipe Association is at present conducting studies to indicate opportunities for the improvement of design of clay tanks produced by its members. This program could very well be paralleled by researches under the sponsorship of the various health departments whose standards must be met by clay tank producers in order to assure acceptance of their product. At any rate, manufacturers of clay tanks, backed by more than 50 years' experience in local sewage disposal, retain their considered opinion that present day health board standards, demand wastefully high tank capacities.

BENJAMIN EISNER, *Chief Engr.*
Clay Sewer Pipe Association, Inc.
Columbus, O., Dec. 3, 1946.

Sanitary Engineering in China:

Dear Sir:

Greetings from Shanghai and China. Fortunately I have had opportunity to travel about in China to some extent. After things quiet down you had better plan to visit us. We will be here to greet you as my family expects to come about the first of the year.

Please list me as a subscriber for your magazine and furnish me, if possible, with your latest Manuals, if they contain, as in previous years information with reference to sanitary engineering equipment.

As you will recall, I was appointed and still am the Chief Sanitary Engineer for UNRRA in China. Our problems are interesting and varied, and I am proud to say I have an excellent though small staff of competent American engineers. Major F. F. Aldridge, USPHS, Chief of the Sanitary Section, UNRRA Washington, did an excellent job of recruiting. Many thanks for your efforts and assistance in getting me out of Germany and into China.

One of my engineers, Major John R. Snell, USPHS, intends to join with me in the formation of an engineering firm when we leave UNRRA, in fact up to the present time he has taken most of the initiative in the project. It is our intention, in addition to rendering the customary water works and sanitary engineering consulting service, to handle equipment and supplies, a practice which as you know is considered entirely ethical in China at the present time.

We already have some excellent prospects with some of the best firms in our line. I should greatly appreciate it if you would assist us in obtaining the names of equipment and supply firms for water works and sewerage which have factories or equipment and supplies in storage on the west coast for ready shipment to China.

D. S. ABELL,
Room 33,
110 Szechwan Road
Shanghai, China.

[*We hope that engineering firms desiring responsible representation in China will contact Mr. Abell.—Ed.*]

PUBLIC WORKS Equipment News

Improved Smith-Mobile Models

Improvements in the design and construction of Smith-Mobile Truck Mixers, announced by The T. L. Smith Company, Milwaukee, Wisconsin, will include: larger drums with increased capacities; selective dual water injection system for job mixing or

Smith truck mixer.

mixing in transit; water pump valve and piping protection for cold weather; a syphon-type water tank; quickly accessible clutches; and complete streamlined enclosure for greater safety.

Four sizes will be available: 2 yard, 3 yard, 4½ yard and 5½ yard Truck Mixers; 3 yard, 4¼ yard, 6⅛ yard and 7⅜ yard Agitators. New catalog may be obtained from the manufacturer. *Add to Chap. 4, Highway and Airport Manual.*

An Expansion Joint Slitter

A new, automatic unit for slitting all types of expansion joints is made by Keystone Asphalt Products Company, Chicago, Ill. This expansion joint slitter is driven by a one horsepower electric motor (or gasoline motor) and will cut all joint materials up to 1½" in thick-

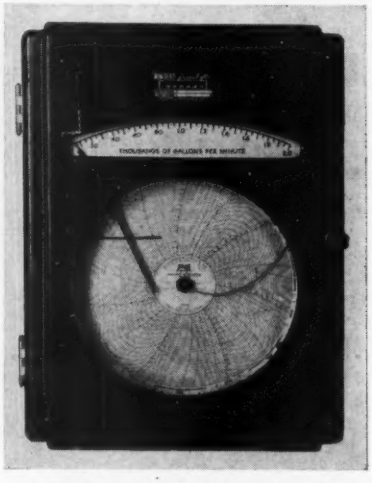
Expansion joint slitter.

ness at the rate of 60 feet per minute. The unit modern and streamlined in every way can be plugged into any connection and is operated by one man. Forward and reverse operation permits cutting in both directions.

Dealers or contractors often can save up to 40% by carload slab type purchases and cutting their own joints to size. Net weight 500 lbs.

Totalizer-Indicator-Recorder

An electrically operated secondary instrument for use with Propeloflo, Shuntflo or other mechanical flow meter,



Proportioneers' totalizer-indicator-recorder.

or as a recording-indicating-totalizing tachometer, has been announced by Builders-Providence, Inc. of Providence, R. I. The instrument is actuated by impulses over a two-wire circuit from a transmitter which is mechanically driven by the primary meter. No power supply is necessary for the primary instrument. The new instrument provides readings of total flow, rate of flow and a chart record of flow over any distance from a few feet to many miles from the primary instrument. Complete information may be had by addressing the manufacturer.

A New Mapping Instrument— The Rectoplanigraph

The Fairchild Camera & Instrument Corporation, Jamaica, N. Y., has developed a new mapping instrument, the rectoplanigraph, to provide the mapmaker with a simple means of rectifying and transferring planimetric detail from aerial photographs to maps and charts. Based on the principle of the camera lucida, the rectoplanigraph is extremely easy to use, and provides a rapid and accurate means of supplying supplementary data to maps and charts.

This is a portable, light-weight instrument easily assembled and disassembled, which can be set on a drafting table. Its design provides indexed adjustments for three focal lengths (6, 8¼ and 12 inches), a micrometer ad-

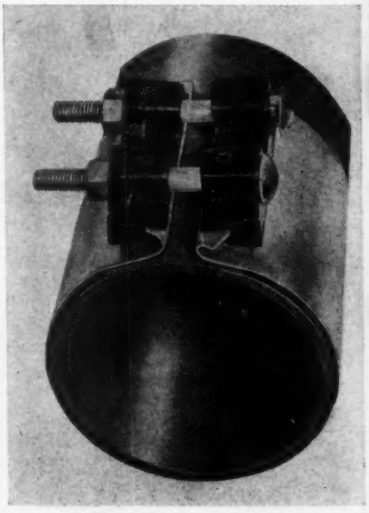
This IHC 76-hp diesel unit now being produced is a companion unit to a 6-cylinder 125-hp unit.

justment for all variations in scale, and other adjustments for rectification of the photographs to compensate for errors introduced by tip and tilt. A picture-holder is fitted with masks to accommodate air-photos ranging from 4" x 5" to 9" x 9". A high quality prism assures a sharp, well-illuminated image.

Pipe Leak Repair Clamp

A new pipe leak repair clamp has been introduced by Smith-Blair, Inc., of South San Francisco, Calif. According to the manufacturer, this clamp has features which make sealing-off of leaks in pipe lines quick and as permanent as the line itself.

Sizes now produced are for pipe from ½ to 30 inches in diameter; and it is adapted for all types of metallic pipe and for asbestos-cement pipe. The clamp has a copper band sleeve which gives



Pipe leak repair clamp.

about 100% wrap-around without using a "tongue."

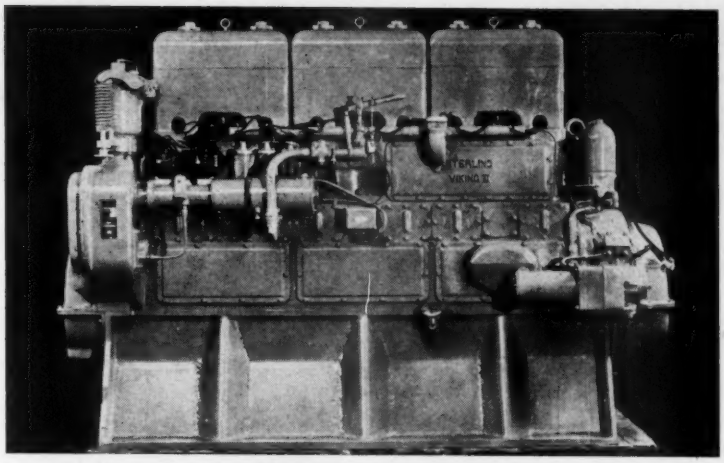
A unique feature of this design is the cast lugs which can be reduced in length for 30-inch sleeves down to 3-inch sleeves in even multiples of 3 inches; this change can be accomplished in the field without special tools or lugs or can be furnished from the factory in any sleeve length.

Caterpillar Resumes Production of No. 212 Motor Grader

Production of the diesel No. 212 motor grader, suspended during the war has been resumed by Caterpillar Tractor Co., Peoria, Illinois. This grader is powered by a rear-mounted, 35-brake horsepower, four-cylinder, four-cycle Caterpillar diesel engine. It is available in both tandem and single drives, and is normally equipped with 10-foot moldboard and leaning front wheels. It is the smallest of three sizes of Caterpillar series "12" motor graders. Specification sheets are available from the manufacturer. Please request Form 1823.

New Drott Buildings Landscaped With Help of Sanitary Fill

The Drott Mfg. Corp. has completed a new, modern office and manufacturing building at 4344 North Green Bay Avenue, Milwaukee 12, Wisc. An unusual, but yet natural method of landscaping its new frontal property was employed. Instead of hauling in dirt to raise the ground to a desired height, refuse from suburban towns was used. In short, this company constructed a sanitary fill in its front yard with its Drott bullclam shovel, the same machine used by numerous cities for this work. It not only proved most economical and satisfactory, but provides an example of a finished sanitary fill for prospective users to see when they call on the company.



One of the 24 Sterling engines for China.

Chinese Water Works to Be Powered by Sterling

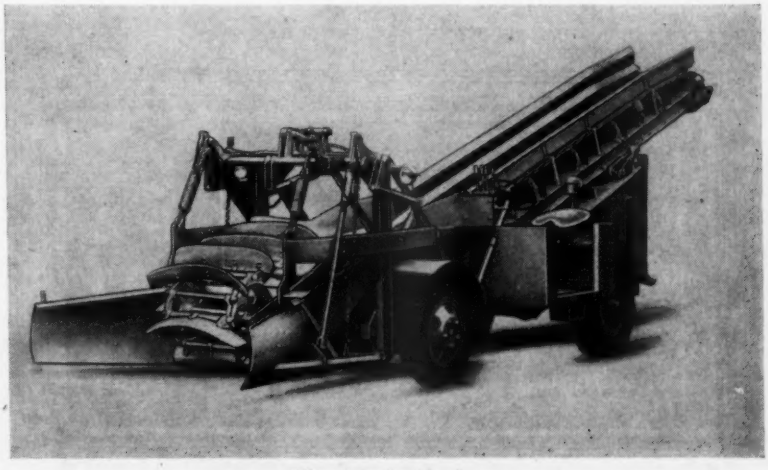
The Sterling Engine Company of Buffalo, New York, has received orders for twenty-four engines to be used for rehabilitation work in China under the U.N.R.R.A. program. Seventeen of the engines are six cylinder Sterling Vikings having 8" bore and 9" stroke. Seven are six cylinder Sterling Petrels having 5¼" bore and 6" stroke.

These Sterling Viking and Petrel engines, which are used extensively throughout the United States for a multitude of power applications, will be used in China to operate water pumps built by Buffalo Pumps, Inc., also of Buffalo. The Viking engines will drive pumps delivering 2500 to 3500 gallons per minute against a 200-foot head or at a pressure equivalent to 86.6 lbs. per sq. inch. The Petrel engines will deliver 1800 gallons per minute against a 270-foot head or at a pressure equivalent to 116.8 lbs. per sq. inch.

Reconstruction of water supply systems with Sterling powered pumping units will do much to alleviate famine and disease in war-torn China.

Athey Force-Feed Loader

Athey Products Corporation, Chicago, Ill., announces the new Model 3 Athey Force-Feed Loader, with "finger-tip" hydraulic control and new features of design. The new unit is designed for such jobs as road widening and resurfacing, ditch building and cleaning, dressing slopes, loading oil mix, etc. There are four levers for raising and lowering feeder, moldboard, throat and conveyor; also a roomy operator's platform, new conveyor and throat design, positive belt alignment, more accessibility, and greater loading efficiency. The new machine will be sold through Athey-"Caterpillar" distributors in this country and abroad. *Add to Chap. 6, Highway and Airport Manual.*



Athey force-feed loader.

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40th Anniversary of Truck Manufacturing Commemorated by International Harvester

The fortieth anniversary of International Harvester Company's truck manufacturing was commemorated at Fort Wayne, Ind., Jan. 17. Fort Wayne is the site of one of the IHC three truck producing plants; others are at Springfield, O., and Emeryville, Cal., while the truck engine plant is at Indianapolis. Before a very large gathering, the new line of IHC trucks was exhibited for the first time, and earlier models of IHC trucks were also shown. The first International truck was a high-wheel, solid tire vehicle, powered with a 2-cylinder engine, chain drive, and with two speeds. In 1915 came a low-wheel truck, and in 1921 a pneumatic tired "speed truck." Then followed the various models culminating in the present line. During these 40 years, the company has produced 1,298,576 trucks, of which more than 600,000 are still in commercial use in the United States.

International KB-7, with 3-yd. dump body.

The new truck line contains 15 basic models, and in addition there are 6 basic models in the recently announced "Western" line. Six "KB" models are produced at the Springfield works, ranging from 4,400 to 17,500 pounds gross vehicle weight ratings. Nine heavy-duty models are produced at Fort Wayne, ranging in capacity from 14,500 pounds to 48,100 pounds. The six "W" models produced at the California plant, have ratings from 30,000 to 90,000 pounds, and are available in both diesel and gasoline powers.

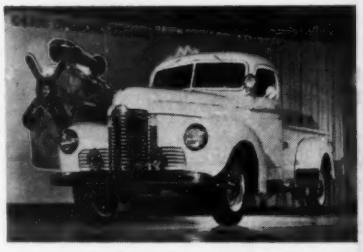
The broad bases of the program for better servicing and handling of IHC trucks were outlined, including the recently introduced point system for rating full carrying capacities, which was described by S. Colacuori, supervisor of sales engineering. Five fatigue factors are employed to calculate the allowable load.

A 1917 model 1½-ton I H C.

The International program of uniform buildings for dealers is the result of a research program to determine of the needs for dealer buildings. This was described by J. W. Simpson, Research Manager. The truck parts and accessories merchandising program, employing a complete dealer parts department, was demonstrated by M. D. Dean, motor trucks parts sales supervisor.

Of special interest and value was the review by D. B. Erminger, service section supervisor, motor truck division, of the special training in servicing given more than 4,000 dealer and fleet mechanics last year. This training is given in the Company's service schools. Each month one of these schools is conducted in six different sections of the U. S. Instructors are experienced company men who have been intensively trained both in their subjects and in teaching methods. Each course is followed by a forum and by examinations.

The new system of pricing, basing the standard price on the equipment most frequently ordered was discussed and IHC policies outlined.



I H C KB-1, pickup body truck.

An interesting and valuable presentation was a paper outlining the history and development of International trucks.

Grates by Bates.—This 16-page catalog and data book tells you pretty much what you need to know about gratings, including uses, reasons for utilization of various types, tables of safe loads, etc. Used in water, sewerage and industrial plants. Walter Bates Co., Joliet, Ill.

Tough Floor Problems.—This is a new folder covering repair and construction of floors subject to acids, grease, oils or severe abrasion; illustrates methods of preventing disintegration; discusses patching, etc. Stonhard Co., 403 No. Broad St., Philadelphia 8, Pa.

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4. Specifications and full information about the new M-M wheel tractors in sizes 27 HP to 49 HP. Send for copies today. Dept. PW, Minneapolis-Moline Power Implement Co., Minneapolis, Minn.

Data on All Types of Bins and Batching Plants

11. Good illustrations and useful data on all types of Heltzel Highway Bins, for truck mixer charging, bulk cement plants, enclosed bucket elevators, belt conveyors, etc. Heltzel Steel Form & Iron Co., Dept. P.W., Warren, O.

Self-Propelled Crane for Every City-County Need

20. Here's a fast, versatile industrial crane with plenty of lift . . . gets there in a hurry on rubber tires . . . one man operates it easily . . . 5 ton capacity—7 ton with outriggers. Send for bulletin PW, Unit Crane & Shovel Corp., 6323 West Burnham St., Milwaukee 14, Wisc.

Truck-Mounted Loader Travels Fast, Loads Quickly

22. New Eagle Truck-Mounted Loader, operated by truck driver, goes from job to job at truck speed. Loads all kinds of material quickly. No costly working parts. Ask for new bulletin PW. The Eagle Crusher Co., Inc., Galion, Ohio.

Solve Your Drainage Problems This Easy, Permanent Way

70. Standard corrugated pipe, perforated pipe and MULTI-PLATE pipe and arches — for culverts, sewers, subdrains, cattlepasses and other uses. 48-page booklet, No. 12. Armco Drainage and Metal Products, Inc., Dept. PW., Middletown, Ohio.

Improve Appearance of Curbs, Gutters, Sidewalks

78. Curb and Gutter and Sidewalk Forms, including battered face curb form especially for modern traffic conditions. Last 20 years or more. Send for new engineering data Bulletin A-20-F, Dept. P.W., Heltzel Steel Form & Iron Co., Warren, O.

Handle All Kinds of Tough Grading Jobs Economically

98. The Austin-Western 99M Power Grader with its powerful all wheel drive handles difficult jobs with economy and efficiency; and does better work on grading, ditching, scarifying, snow ploughing, loading, mixing, bulldozing, shoulder trenching and backsloping. Write for Bulletin 1946. Dept. P.W., Austin-Western Co., Aurora, Ill.

One Man Operates This Self-Contained Gas Hammer

110. Powerful self-contained gasoline hammers illustrated in new booklet. Used as paving breakers and spike drivers. Easily portable, economical. Write Syntron Co., 660 Lexington, Homer City, Pa.

Methods of Installing Steel Sheet Piling

112. Illustrated descriptions of both standard and interlock corrugated steel sheet piling of minimum weight, maximum strength, ease of handling with methods of installation are contained in a booklet. If you have a job involving piling write Caine Steel Co., Dept. P.W., 1820 N. Central Ave., Chicago 39, Ill.

Reliable Pumps for Every Purpose

117. New brochure by Gorman-Rupp Co., Mansfield, Ohio, illustrates and describes many of the pumps in their complete line. Covers heavy duty and standard duty self-priming centrifugals, jetting pumps, well point pumps, triplex road pumps and the lightweight pumps.

Small Diesel Engines Have Many Municipal Uses

393. Small Diesel engines — down to 3¾ HP. The only stationary Diesel that is air-cooled. For full details on this revolutionary engine for municipal service write R. H. Sheppard Co., 50 Middle St., Hanover, Pa.

Need Street, Sewer or Water Castings?

429. Street, sewer and water castings in various styles, sizes and weights. Manhole covers, water meter covers, adjustable curb inlets, gutter crossing plates, valve and lamphole covers, ventilators, etc. Described in catalog P.W. issued by South Bend Foundry Co., Lafayette Boul. and Indiana Ave., South Bend 23, Ind.

SNOW FIGHTING

For High-Speed Snow Removal

350. "Frink One-Way Sno-Plows" is a four page catalog illustrating and describing 5 models of One-Way Blade Type Sno-Plows for motor trucks from 1½ up to 8 tons capacity. Interchangeable with V Sno-Plow. Frink Sno-Plows, Inc., Clayton, 1000 Islands, N. Y.

Fast, Efficient Skid-Proofing

355. Get full facts about Baughman Light-Weight Cinder Spreaders, fast operators for cinders, sand, salt, chips, etc. Free flowing at low temperatures. 9-17 cu. yd. cap. Write Dept. P.W., Baughman Mfg. Co., Inc., Jerseyville, Ill.

STREETS AND HIGHWAYS

Levels Sidewalks and Curbs Quickly and Easily

107. How the Mud-Jack Method for raising concrete curb, gutter, walls and streets solves problems of that kind quickly and economically without the usual cost of time-consuming reconstruction activities—a new bulletin by Koehring Company, 3026 West Concordia Ave., Milwaukee 10, Wis.

How to Build and Maintain Roads With Tarvia

111. New "Tarvia Manual" is packed with useful data on how to build and maintain roads with Tarvia. Each step is illustrated with excellent action pictures, 64 pp. 103 illus. Write to The Barrett Div., 40 Rector St., New York 6, N. Y.

Speed Your Work With These Powerful Motor Graders

128. Two powerful Galion motor graders designed to answer every requirement for more speed in road, airport, dam and housing construction work are fully described in a folder illustrated with many action pictures. Issued by Galion Iron Works & Mfg. Co., Galion, Ohio.

Tandem, 3 Wheel and 3 Axle Road Rollers

138. "The Buffalo-Springfield" line of road rollers (tandem, 3-wheel, and 3-axle) are described in the latest catalog P.W. issued by the Buffalo-Springfield Roller Co., Springfield, Ohio.

Here's a Roller for Every Need

141. Three-Wheel and Tandem Rollers, 5 to 8-ton and 10 & 12 ton sizes: also variable weight tandem roller for new highway surfacing and old road conditioning. Ask for new bulletin. Dept. P.W., Huber Mfg. Co., Marion, Ohio.

Here's Your Diesel Tractor!

190. Big 48 page catalog describes and lists many uses for International Diesel Tractors. Write International Harvester Co., Dept. P.W., 180 North Michigan Ave., Chicago 1, Ill.

Latest Maintenance Equipment For Blacktop Roads

290. "Blacktop Road Maintenance and Construction Equipment" — Asphalt and tar kettles, flue type kettles, spray attachments, tool heaters, surface heaters, road brooms and rollers. This is modern and up-to-date equipment for blacktop airport and road construction and maintenance. Write for Catalog R. Littleford Bros., Inc., 452 East Pearl St., Cincinnati 2, Ohio.

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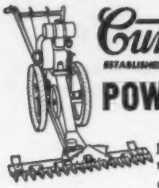

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375. Gar Wood special bodies for sanitary refuse collection are illustrated and described in a new catalog issued by Gar Wood Industries. Dept. P.W., Wayne, Mich.

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510. Send for latest literature about the Cunningham Mower for Fence Rows, Parking Areas, Driveways, Picnic Grounds and many other jobs. 3 ft. cut, variable speed, rugged, easy to handle. James Cunningham, Son & Co., Dept. 16, 13 Canal St., Rochester 8, N. Y.

Tandem Roller with Air Clutches Starts and Shifts Easier

515. Finger tip steering, air clutches, full visibility all around, low center of gravity, handy location of key parts, all gear drive are features of new Apsco tandem roller. Write for bulletin: Dept. PW, All Purpose Spreader Co., Fuller Road, Elyria, Ohio.

SEWAGE DISPOSAL

Non-Corrosive, Long Lasting Low Cost of Sewer Pipe

72. Get this new engineering data on clay pipe for sewers. Withstands acid, alkali and gas attacks indefinitely. Cuts maintenance costs to a minimum. Write Dept. P.W., National Clay Pipe Mfrs., 111 W. Washington St., Chicago 2, Ill.

Does Air Sabotage Your Pipe Lines and Pumps?

357. Automatic Air Release Valves for water, sewage and industrial uses automatically vent air accumulations. Ask for latest illustrated engineering bulletins. Simpex Valve & Meter Co., 6750 Upland St., Philadelphia 42, Pa.

Valuable Booklet on Porous Diffuser Plates and Tubes

367. A valuable booklet on porous diffuser plates and tubes for sewage treatment plants. Covers permeability, porosity, pore size and pressure loss data, with curves. Also information on installations, with sketches and pictures, specifications, methods of cleaning and studies in permeability, 20 pp. illustrated. Write to Norton Company, Dept. P.W., Worcester 6, Mass.

It's No Trick to Clean Sewers This Modern Way

386. 32-page illustrated booklet explains how a city can clean its sewers and culverts with its own forces using the up-to-date Flexible Sewer Rod equipment. Illustrates and describes all necessary equipment. Issued by Flexible Sewer Rod Equipment Co., 9059 Venice Boulevard, Los Angeles 34, Calif.

How Cities Can Do Complete Sewer Cleaning From Street

387. Literature illustrating how cities, towns and villages using OK Champion Sewer Cleaners are doing a complete sewer cleaning job from street level. Three sizes of machines available in addition to full line of sewer rods and accessories. Issued by Champion Corporation, 4752 Sheffield Avenue, Hammond, Indiana.

Diesels for Small and Medium Power Service

394. "Blue Streak" engines for 425 and 495 hp are described in Bulletin No. S 329; also Bulletins SA 341 and 342 for small and medium power service. Write Climax Engineering Co., Dept. P.W., 111 W. Monroe St., Chicago, Ill.

Solves Your Sludge Filter Problem

403. Latest bulletins give full facts about Vacuum Filters for dewatering primary, activated, digested or chemical sludge. Write The Conkey Co., Dept. P.W., 420 Lexington Ave., New York 17, N. Y.

All About Flow Meters

409. The primary devices for flow measurement—the orifice, the pitot tube, the venturi meter and others—and the application to them of the Simplex meter are described in a useful 24-page booklet (No. 300). Simplex Valve and Meter Co., 6750 Upland St., Philadelphia 42, Pa.

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WHEELER FALSE FILTER BOTTOMS
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USE COUPON ON PAGE 69

How to Combat Corrosion In Your Gas Holder

412. A 16-page bulletin gives detailed information on the development of corrosion—and how to combat it—in gas holders. A copy will be mailed on request to The Stacey Bros. Gas Construction Company, 5535 Vine St., Cincinnati 16, Ohio.

Make Low-Cost Electricity From Cheap Fuel

422. New booklet describes Sheppard Diesel Generating Sets that make low cost electricity from cheap fuel and give dependable service in the hands of any average operator. Write R. H. Sheppard Co., 250 Middle St., Hanover, Pa.

Diesel Generators That Use "No Cost" Sewage Gas

420. Le Roi engine-generator units for operating on "no cost" sewage gas are fully described and illustrated in new bulletins now available. Address Le Roi Co., 1770 S. 68th St., Milwaukee 14, Wis.

How to Select Main Line Meters

432. New bulletin illustrates Builders Air Relay system for liquids containing suspended solids like sewage. Eliminates corrosion, clogged pipes, etc. "The Selection of Main Line Meters," a highly informative and useful presentation, describes forms of differential producers and quickly solves typical problems with the use of graphic charts. Write Builders-Providence, Inc., Dept. P.W., 9 Codding St., Providence 1, R. I.

How to Make Better Sewer Pipe Joints

447. How to make a better sewer pipe joint of cement—tight, minimizing root intrusion, better alignment of joint. Permits making joints in water-bearing trenches. General instructions issued by L. A. Weston, Dept. P.W., Adams, Mass.

Here's a Modern, Faster Joint for Sewer Pipe!

448. Asphaltic Sewer Jointing materials are described and instructions for using them are included in a folder. Premoulded Sewer Pipe Belt, a modern method of jointing, a faster installation on the job, and Tuffiex, a cold troweling plastic for Sewer Pipe joints are the products of Servicised Products Corp., 6051 W. 65 St., Chicago 38, Ill.

Here's Data on All Kinds of Pumps

458. Performance data and illustrations on all kinds of pumps for all uses. Address: Dept. P.W., American Well Works, Aurora, Ill.

Save Trucks and Labor In City Rubbish Collection

459. For saving trucks, labor, and time in city rubbish collection get details of the new Dumpster-Kolector described in literature just published by Dempster Brothers, Inc., 996 Higgins, Knoxville 17, Tenn.

Incineration From the Commonsense Standpoint

462. "Disposal of Community Refuse by Incineration" is a handsome 34-page booklet that discusses incineration from a commonsense standpoint. Illustrated by numerous photos of typical installations and includes diagrammatic outlines of various plant designs. Write Morse Boulger Destructor Co., 207-P East 42nd St., New York 17, N. Y.

An Incinerator Necessity

463. Recuperator tubes made from Silicon Carbide and "Fireclay" Corebusters for maximum efficiency are described and illustrated in bulletin No. 11 issued by Fitch Recuperator Co., Dept. P.W., Plainfield National Bank Bldg., Plainfield, N. J.

Ask for This Design Data On Sprinkling Filters

469. Design data on sprinkling filters of Separate Nozzle Field and Common Nozzle Field design as well as complete data on single and twin dosing tanks, and the various siphons used in them, for apportioning sewage to nozzles. Many time-saving charts and tables. Write Pacific Flush Tank Co., Dept. P.W., 4241 Ravenswood Ave., Chicago 13, Ill.

Design Details for Sludge Collectors

480. Booklet No. P.W. 1642 on Link-Belt Circuline Collectors contains sanitary engineering data and design details. Catalog No. 1742 on Straightline Collectors, contains layout drawings, installation pictures and capacity tables. Address Link-Belt Co., 2045 West Hunting Park Ave., Philadelphia 40, Pa.

Packaged Sewage Treatment— Just Right for Small Places

488. "Packaged" Sewage Treatment Plants specifically developed for small communities — 100 to 3,000 population. Write for full description and actual operating data for this type of plant. Chicago Pump Co., 2348 Wolfram St., Chicago 18, Ill.

Look Into This Sewage Treatment Equipment

490. New bulletin P.W. fully describes and illustrates Hardinge sludge collectors for clarifiers, sludge concentration and skimming in both circular and rectangular tanks. Write Dept. P.W., Hardinge Company, Inc., York, Pa.

Need Equipment for Small Sewage Plant?

491. Small type Conveyor Sludge Collector and Skimmer, Grit Collector, Aero-Filter and other equipment for small sewage treatment plants are described and illustrated in bulletins from Chain-Belt Co., 1722 West Bruce St., Milwaukee 4, Wis.

Glazed Clay Blocks for Trickling Filter Underdrains

492. Illustrated bulletin describes the Natco Unifilter block of glazed, hard burned clay for underdraining filter beds. Write National Fireproofing Corp., Pittsburg 12, Pa., for free copy.

Engineering Details of Armcre Filter Blocks

525. Engineering bulletin shows construction details of Armcre Filter Bottom Blocks for better trickling filter results. Tells how Armcre blocks meet all requirements. Write to Ayer-McCarel-Reagan Clay Co., Brazil, Ind.

For Completely Successful Trickling Filter Systems

526. Armcre Filter Bottom Blocks by BOSCO. 12-page illustrated booklet explains how Armcre blocks meet every requirement for successful trickling filter operation. Gives full specifications and construction details. Includes use for Bio-Filtration. Write Bowerston Shale Co., Bowerston, Ohio.

One-Unit and Two-Unit Vitrified Floor Systems

527. Metro one-unit and two-unit vitrified clay blocks for trickling filter floors are described in illustrated catalog. Includes construction drawings, pictures and complete specifications. Ask for your copy today. The Metropolitan Paving Brick Co., Canton, Ohio.

All About Translot Filter Bottom Blocks

528. Illustrated Engineering Bulletin gives full data about Translot Filter Blocks for Trickling Filters. Shows typical sections, installation views, etc. Write Cannelton Sewer Pipe Co., Cannelton, Ind.

For All Sludge Dewatering

601. The first filters to be used in large scale operation on primary, elutriated and Guggenheim sludges. Ask for latest engineering Bulletin P.W. General American Process Equipment Div., 10 E. 49th St., New York, N. Y.

Low Cost Air for Sewage Disposal

602. All interested in low cost air for sewage disposal will want a copy of this

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Operates Anywhere

Makes Smooth Finished Surface

Apsco Road Widener or Trench Filler Handles Any Material

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USE COUPON ON PAGE 69

useful booklet. Describes operating principles and specifications of Roots-Connersville Aerating Blowers. Write to Roots-Connersville Blower Corp., 301 Valley Ave., Connersville, Ind.

WATER WORKS

For All Water Tank Maintenance Troubles

389. For all water tank maintenance troubles, whether the need is for repairs, painting, welding, or cleaning, get latest literature of Chicago Tank and Bridge Co., 618 Empire Bldg., Rockford, Ill.

Solve Corrosion Problems With This Special Alloy

391. "Everdur Metal" is title of an 8-page illustrated booklet describing advantages of this corrosion-resisting alloy for sewage treatment equipment, reservoir, and waterworks service. Dept. P.W., the American Brass Co., 25 Broadway, N. Y. C.

To Measure, Mix, Feed Chlorine or Other Gases

397. Everson SterElators. Bulletins 1063, 1066, 708 and others describe this device for measuring, mixing and feeding chlorine or other gases in solution. Capacities range from ¼ lb. to 2,000 lb. of gas per 24 hours. Address: Everson Manufacturing Co., 214 W. Huron St., Chicago 10, Ill.

Make Water Extra Safe

399. Safe water may be one of the civic improvements your citizens expect soon. Feeders of all types including Hypochlorinators, Reagent Feeders, Dry Chemical Feeders, Chlorinators and Ammoniators for feeding all of the usual chemicals used in sanitation practice. Ask for latest catalogs. Dept. P.W., Wallace & Tiernan Co., Newark 1, N. J.

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FRINK SNO-PLOWS OF CAN., Ltd., TORONTO, ONT.

Helpful Data on Hydrants

405. Specifications for standard AWWA fire hydrants with helpful instructions for ordering, installing, repairing, lengthening and using. Issued by M. & H. Valve & Fittings Co., Dept. P.W., Anniston, Ala.

88 Page Book Helps Solve Laboratory Problems

423. pH and Chlorine Control. A discussion of pH control and description of comparators, chlorimeters and similar devices. An 88-page booklet. W. A. Taylor & Co., 7304 York Road, Baltimore 4, Md.

It's Easy to Use This Leak Locator

426. Leak Locators. Again available to waterworks superintendents, the Globe line of leak locators, dipping needles and pipe finders. Several leaflets describing the original Geophone leak locator, Little Wonder pipe phone, and the Magnetite Dipping Needle. Globe Phone Mfg. Corp., Dept. P., Reading, Mass.

Find Your Leaks In a Jiffy

427. For tracing buried pipes and finding hidden leaks get detail of Allen-Howe Leak Detectors, Pipe Locators, Dipping Needle and Pipe Phones. Ask for new circular P.W. 6, Allen-Howe Electronics Corp., 150 Main St., Peabody, Mass.

What You Should Know About Meter Setting and Testing Equipment

431. The most complete catalog we have seen on setting and testing equipment for water meters—exquisitely printed and illustrated 48-page booklet P.W. you should have a copy of. Ask Ford Meter Box Co., Wabash, Ind.

Cast Iron Pipe Handbook—Handy Pocket Size

436. Handbook of Universal Cast Iron Pipe and Fittings, pocket size. 104 pages, illustrated, including 14 pages of useful reference tables and data. Sent by The Central Foundry Co., Dept. P.W., 386 Fourth Ave., New York 16, N. Y.

Cast Iron Pipe and Fittings For Every Need

437. Cast iron pipe and fittings for water, gas, sewer and industrial service. Super-deLavaud centrifugally-cast and pit-cast pipe. Bell-and-spigot, U. S. Joint, flanged or flexible joints can be furnished to suit requirements. Write U. S. Pipe and Foundry Co., Dept. P.W., Burlington, N. J.

Do You Have This Data On Cast Iron Pipe?

438. "Cast Iron Pipe and Fittings" is a well illustrated 44 page catalog giving full specifications for their complete line of Sand Spun Centrifugal Pipe, Fire Hydrants, Gate Valves, Special Castings, etc. Will be sent promptly by R. D. Wood Co., Dept. P.W., Public Ledger Building, Independence Square, Philadelphia 5, Pa.

How to Make Concrete Pipe on the Job

440. Making concrete pipe on the job to give employment at home is the subject of a booklet sent on request by Quinn Wire & Iron Works, 1621 12th St., Boone, Ia., manufacturers of "Heavy Duty" Pipe Forms.

Concrete Pipe With Greater Elasticity

442. Lock Joint Reinforced Concrete Sewer Pipe, Pressure Pipe, Culvert Pipe, Centrifugal Pipe and Subaqueous Pipe is described and illustrated in bulletins available from Lock Joint Pipe Co., Ampere, N. J.

Makes Underground Pipe Installations Easy

444. One-man-operated Hydraulic Pipe Pusher pushes pipe through ground under streets, sidewalks, lawns and other obstacles. Pays for itself in man hours saved on first few jobs. For complete facts and prices, ask for booklet S-117, Greenlee Tool Co., 2042 Columbia Ave., Rockford, Ill.

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Interesting Facts About Transite Pipe

445. Two new illustrated booklets, "Transite Pressure Pipe" and "Transite Sewer Pipe" deal with methods of cutting costs of installation and maintenance of pipe lines and summarize advantages resulting from use of Transite pipes. Sent promptly by Johns-Manville Corp., Dept. P.W., 22 East 40th St., New York 16, N. Y.

Need a Water-Tight Pipe Joint?

449. Full information on "Hydro-Tite" jointing compound for bell and spigot pipe, together with specifications, instructions; and illustrations both on it and "Fibrex" sanitary joint packing are contained in handsome 48-page booklet. Address: Hydraulic Development Corp., Dept. P.W., 50 Church St., New York.

How to Estimate Quantity Of Joint Compound Needed

450. The uses of Tegul-Mineralead for bell and spigot pipe and G-K Sewer joint compound are described in a 16-page illustrated booklet issued by Atlas Mineral Products Co., Mertztown, Pa. Includes useful tables for estimating quantities needed.

Data on High Efficiency Well Water Systems

454. Installation views and sectional scenes on Layne Vertical Centrifugal and Vertical Turbine Pumps fully illustrated and including useful engineering data section. Layne Shutter Screens for Gravel Wall Wells. Write for descriptive booklet P.W., Adv. Dept., Layne & Bowler, Inc., Box 186, Hollywood Station, Memphis 8, Tenn.

Want Clear, Soft, Iron-Free Water?

467. Water Softening. The use of the Spaulding Precipitator to obtain maximum efficiency and economy in water softening is described in this interesting technical booklet. Permutit Co., Dept. P.W., 330 W. 42nd St., New York 18, N. Y.

Are You Thinking About A Swimming Pool?

472. Data and complete information on swimming pool filters and recirculation plants; also on water filters and filtration equipment. For data, prices, plans, etc., write Roberts Filter Mfg. Co., 640 Columbia Ave., Darby, Pa.

Eliminate Taste and Odor From Your Water

474. Technical pub. No. P.W. 207 issued by Wallace & Tiernan Co., Inc., Newark 1, N. J., describes in detail taste and odor control of water with BREAK-POINT Chlorination. Sent free to any operator requesting it.

Treating Water With Copper Sulphate

496. "Use of copper sulphate in water treatment plants" contains valuable data on chemicals, dosage, etc. Ferri-floc Ferric Sulphate—a new, valuable booklet P.W. on coagulation for water and sewage treatment plants. Write Tennessee Corporation, Atlanta 1, Ga.

How to Stabilize Lime Softened Water

498. Engineering Bulletin describes stabilizing lime-softened water by recarbonation, discusses gas production, washing, compressing, drying, and applying the CO (2). Infilco, Inc., 325 West 25th Place, Chicago 16, Ill.

Outdoor Water Service Devices That Do Not Freeze

506. Data on anti-freeze outdoor drinking fountains, hydrants, street washers, etc., contained in Catalog L. Sent promptly on request to Murdock Mfg. & Supply Co., 426 Plum St., Cincinnati 2, Ohio.

Here's Data on All Swimming Pool Needs

508. Well illustrated bulletin describes Filters, Water Softeners, Hydrogen Ion Plants and Complete Equipment for Swimming pools, etc. Copy sent on request by Dept. PW., Chemical Equipment Co., 223 Center Street, Los Angeles 54, Calif.

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THE SHEPPARD *Diesel delivers steady, low-cost power independent of outside interference.*

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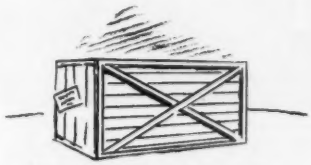

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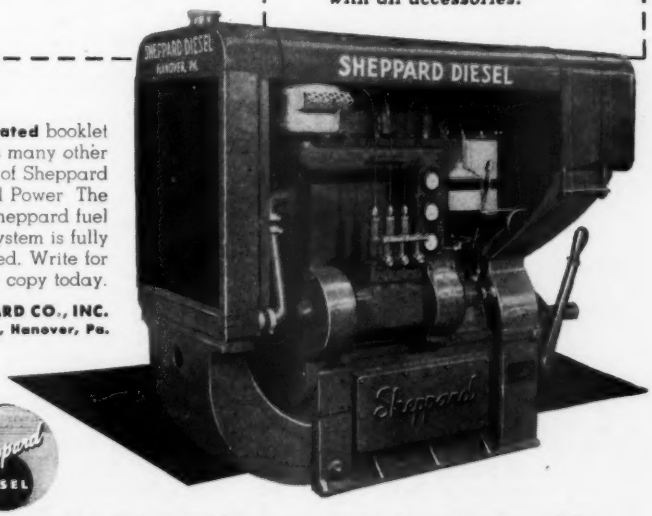

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Sheppard's the Diesel

USE COUPON ON PAGE 69

PUT THE "BEE" ON THEM

Prompt action now unquestionably will prevent serious delays in improvements planned for spring and early summer.

If your orders for Murdock Outdoor Drinking Fountains, Hydrants and Hose Boxes are being unduly delayed, put the "bee" on those responsible.

We'd like to please you as much as you'd like to be pleased.

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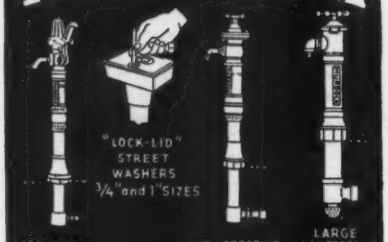
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WANTED—College graduate engineer with experience for position as Assistant Manager of a municipally owned water works system serving a population of 75,000. State age, qualifications, and experience. Salary $4,200.00 per year. Write Box 102 care Public Works Magazine.

Man qualified by education and experience desires job as City Engineer, Supt. of Water Dept. Write Box 101 care of PUBLIC WORKS Magazine.

Chief of Water and Sewerage for Philippines and vicinity, P-5 rating, salary $5905 plus 25%. Headquarters at Manila. Also Chief of Utilities Branch, rating P-6, salary $7102 plus 25%; same location as above. Apply Civilian Personnel Branch, Office of Chief of Engineers, Washington, D. C.

Man with experience and fair degree of maturity wanted for stream pollution investigation and control. Location, southeast; salary, about $4950. Write RC, c/o Public Works.

Montclair, N. J., has openings for junior and senior engineers, salaries $2280 to $4000; drafting, surveying and designing sewers, streets and bridges. F. M. Galloway, Town Engr., Montclair.

Cast Iron Pipe For Sale

FOR SALE, cast iron pipe (soiled). This pipe part of City Chemical Sewage Disposal plant. All pipe flanged from 4" to 14" diameter including elbows, tees, etc.; also valves. A.M.A. Corporation, P. O. Box 63, Rockville Centre, N. Y.

PERSONAL NEWS

Wiley & Wilson, consulting engineers, Lynchburg and Richmond, Va., have admitted as partners W. Martin Johnson, Edgar B. Boynton, W. E. Royall and V. L. Wood.

Shoefcraft, Drury and McNamee, Ann Arbor, Mich., has added Samuel D. Porter as a member of the firm.

Burns & McDonnell Engineering Co., Kansas City, Mo., has admitted as partners Arthur F. Hartung, Russell G. Kincaid, C. Kelsey Mathews, and Earl J. Thomson.

Wood and Preuit Engineering Co., formerly of Luther and Wood, has been formed. This new firm will handle engineering equipment in Washington, D. C., with offices at 1018 18th St. N. W. Members of the firm are Alan A. Wood, Richard I. Preuit, Conrad C. Wilbur and David A. Wood.

Arthur F. Wirtz, secretary-treasurer of Atlas Mineral Products Co., Mertztown, Pa., died Dec. 16.

Purdue Waste Utilization Conference

The Third Industrial Waste Utilization Conference will be held at Purdue University, Lafayette, Ind., on May 21 and 22, 1947. Prof. Don E. Bloodgood is Conference Chairman.

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Minneapolis Moline Power Implement Co. 4
Moore & Owen 6
Murdock Mfg. & Supply Co. 7

National Fireproofing Corp. 3
Nichols Engrg. & Research 6

Pacific Flush Tank Co. 3
Pirnie, Malcolm 6
Proportioneers, Inc. 6

Quinn Wire & Iron Works. 5

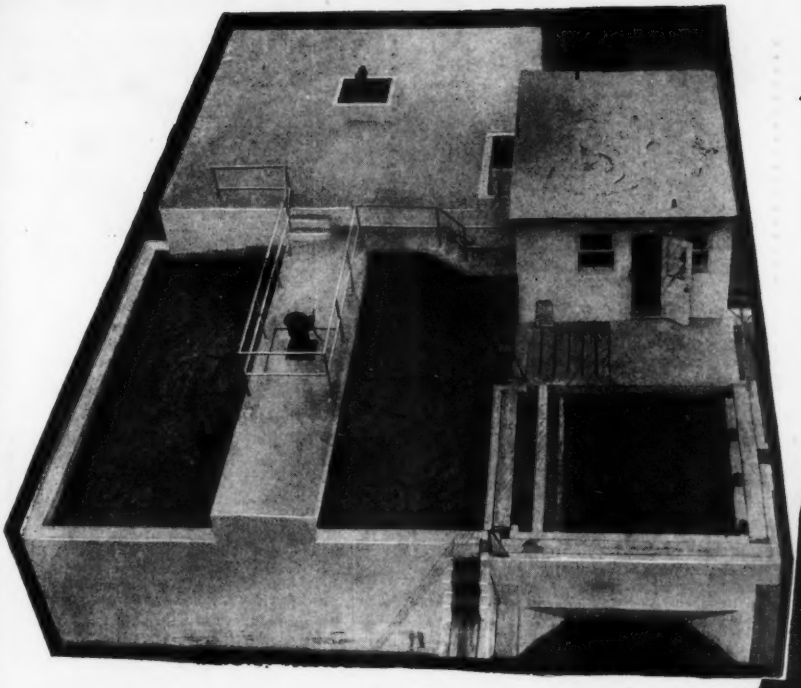
Robert & Co., Inc. 6
Roberts Filter Manufacturing Co. 7
Roots-Connersville Blower Corp. 5
Russell & Axon Cons. Engrs., Inc. 6

Sheppard Co., Inc., R. H. 7
Simplex Valve & Meter Co. 1
Sirrine & Co., J. E. 6
Snell, Inc., Foster D. 6
South Bend Foundry Co. 6
Stacey Bros. Gas Construction Co. 1
Stanley Engineering Co. 6
Sterling Machinery Corp. 6
Stillson & Assoc., Alden E. 6
Syntron Co. 6

Taylor, Henry W. 6
Taylor, W. A. 7
Tennessee Corp. 6

Unit Crane & Shovel Corp. 4
U. S. Pipe & Foundry. 5

Wallace & Tiernan Co., Inc. B C
Weston, L. A. 5
Wood Co., R. D. 6



Chicago "Package" Sewage Treatment Plant at the Eastern Air Lines Terminal, Miami, Fla. The primary tank is in the right foreground. Behind it is the pump house. Left foreground is the Combination Aerator-Clarifier. Aeration and clarification are performed in this single tank. Behind it is the digester.

CHICAGO "PACKAGE" SEWAGE PLANTS

OVER 100 IN SUCCESSFUL OPERATION LAST 12 YEARS

COMPLETE . . . CONSISTENT . . . NUISANCE-FREE SEWAGE TREATMENT FOR SMALL COMMUNITIES

Tailored to requirements • Low first cost • Simple to operate by local man • Located close to residences without odor or fly nuisance • Neat in appearance • Space saving • Consistent sparkling clear effluent.

Complete engineering data furnished Consultants so they can apply "Package" Plants to any small community, housing project, institution, airport or industrial plant.

NOTABLE, EXCLUSIVE CONTRIBUTIONS TO SEWAGE TREATMENT

"PACKAGE" PLANTS
SWING DIFFUSERS
COMMINUTORS
FLUSH-KLEENS
SCRU-PELLERS

CHICAGO PUMP COMPANY

SEWAGE EQUIPMENT DIVISION

2348 WOLFRAM STREET — **CHICAGO 18, ILLINOIS**

Flush-Kleen, Scru-Peller, Plunger, Horizontal and Vertical Non-Clogs, Water Seal Pumping Units, Samplers.

Swing Diffusers, Stationary Diffusers, Mechanical Aerators, Combination Aerator-Clarifiers, Comminutors.

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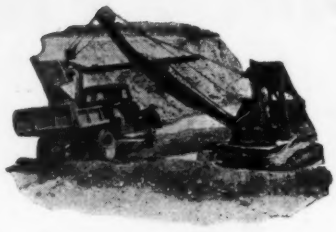
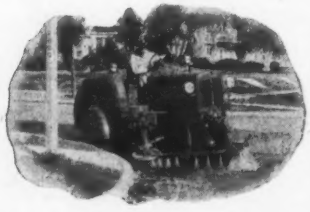
MARCH, 1947

"99-H" POWER GRADER—Exclusive All-Wheel Drive and All-Wheel Steer plus High-Lift Blade, Extreme Blade Reach and Completely Reversible Blade guarantee superlative performance on every job.

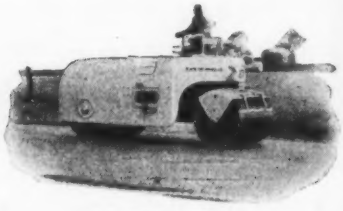
NO. 55 MOTOR GRADER—Engineered to handle a wide variety of maintenance and light grading jobs quickly, easily, and economically. May be had with scarifier attachment.



BADGER SHOVEL—Convertible to crane, dragline, piledriver, trench hoe, and skimmer. ¾-swing design has many operating advantages.



MODEL "40" PATROL SWEEPER—Available with right-hand or left-hand gutter broom, or both. Rear broom throws dirt directly into hopper. May be had with Leaf Broom attachment.



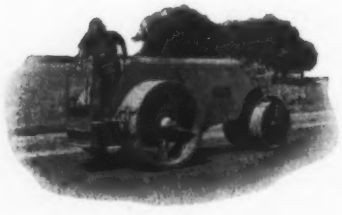
TANDEM ROLLERS—Made in 2 sizes—5 to 8-Ton and 8 to 10½-Ton. The variable weight feature enables one machine to handle a wide variety of work.

BUILT *to* OUTPERFORM

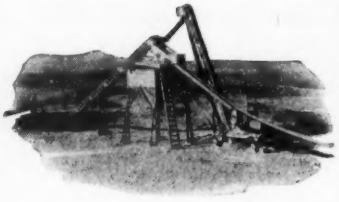
"Plus values" built into every Austin-Western machine . . . exclusive features that save time and money by getting the job done better and quicker . . . engineering experience dating back to the first crude Austin-Western tools of 1859, culminating in the new Power Grader and Street Sweeper models shown on this page, and other new models not yet in production.

Your nearby A-W Distributor is an especially good man to know in these days of postwar changes and developments.

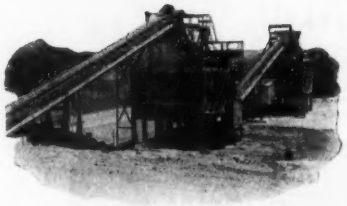
AUSTIN-WESTERN COMPANY, AURORA, ILLINOIS, U. S. A.



3-WHEELED ROLLERS—Made in sizes ranging from 6 to 12 tons. Gasoline or diesel engines. Hydraulic power steer. Hydraulic scarifier attachment.



PORTABLE CRUSHING PLANTS—Range in size from that illustrated to the magnificent Triple Unit Plant with its Primary, Secondary and Reduction Crushers.



STATIONARY CRUSHING PLANTS—Engineered to meet individual requirements; employing any desired combination of Crushers, Conveyors, Screens and Bins.

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Austin-Western

SINCE 1859

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